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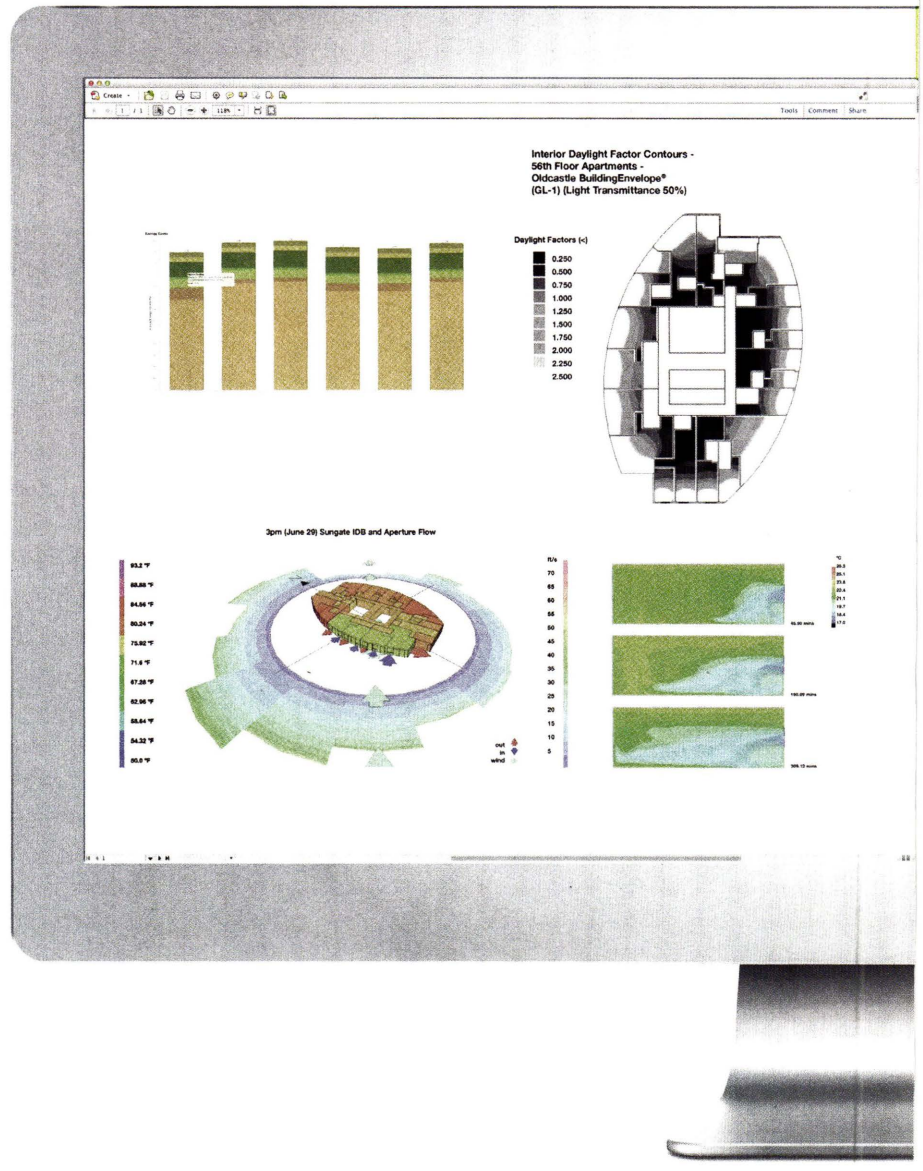
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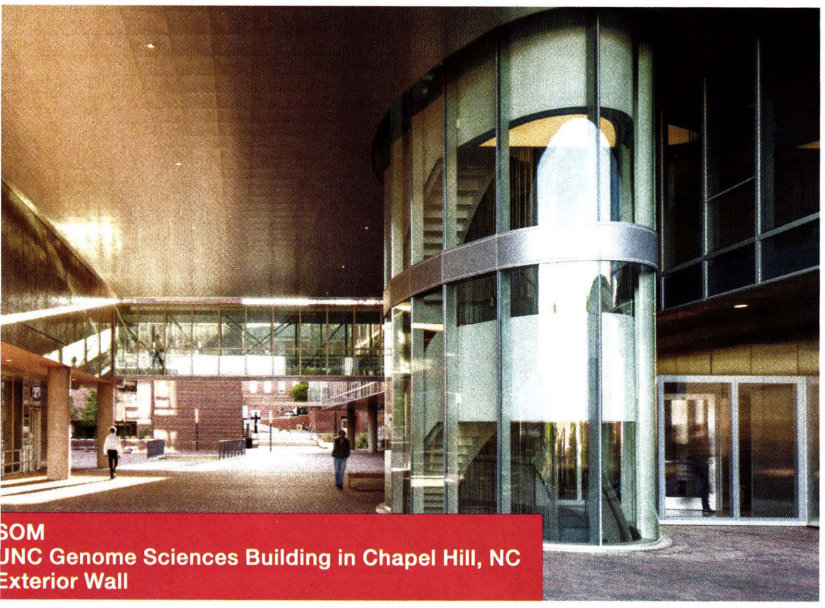
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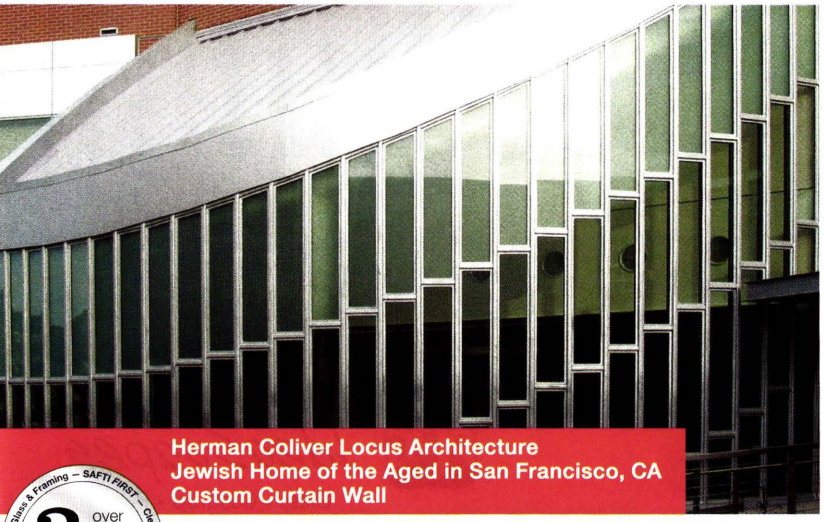
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CONTRIBUTING ILLUSTRATOR, PRESENTATION DRAWINGS	Peter Coe
EDITORIAL SUPPORT	Monique Francis, *monique.francis@construction.com*
CONTRIBUTING EDITORS	Sarah Amelar, Fred A. Bernstein, Robert Campbell, FAIA, C.J. Hughes, Clare Jacobson, Blair Kamin, Jayne Merkel, Josephine Minutillo, Robert Murray, David Sokol, Michael Sorkin, Ingrid Spencer
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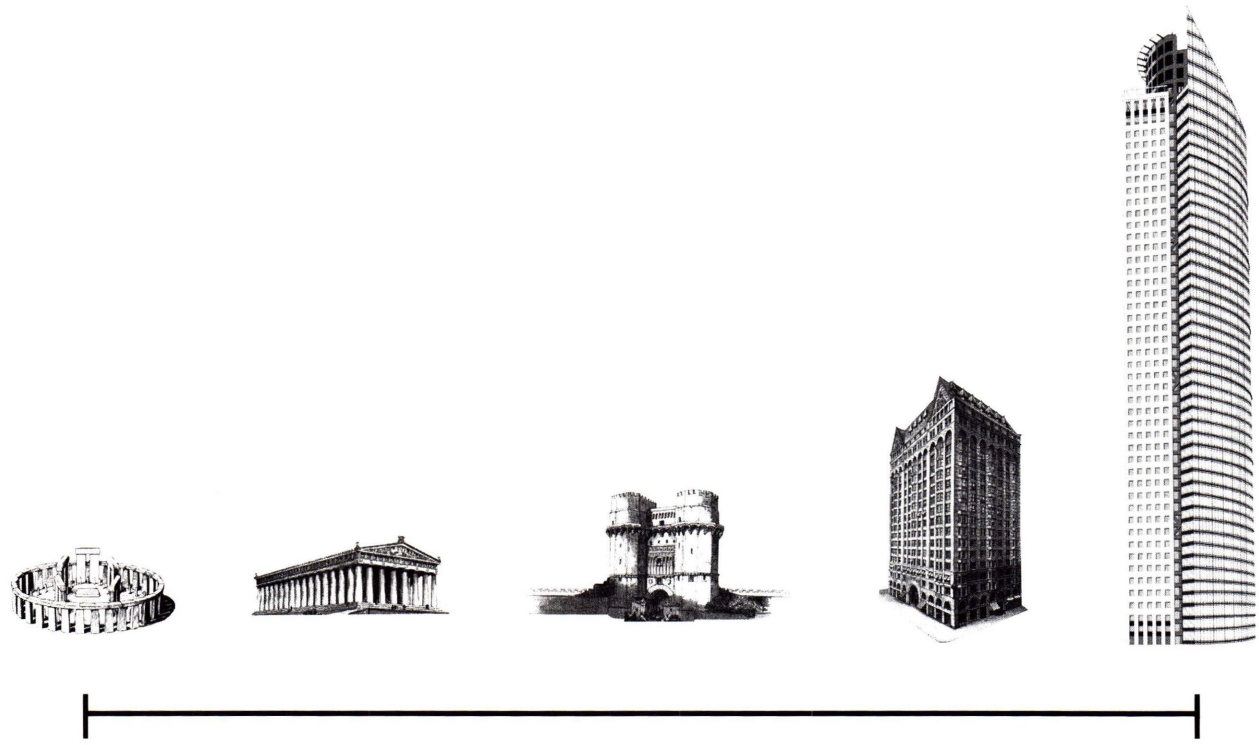
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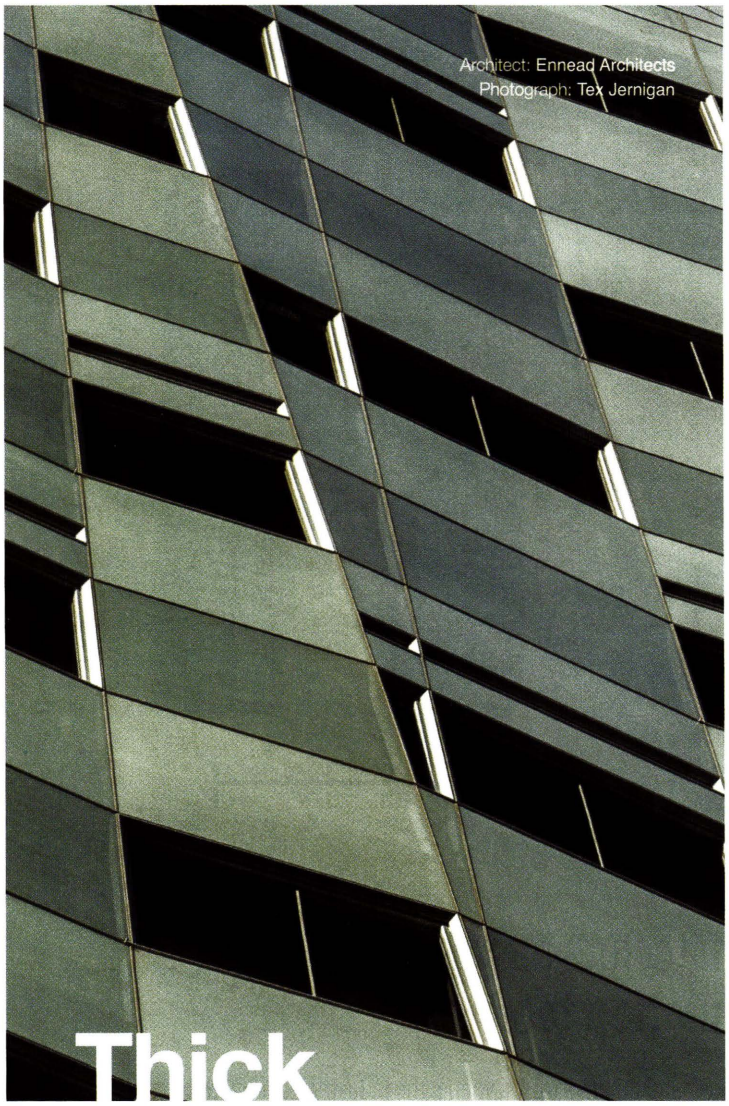
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ADVERTISING SALES

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PACIFIC/TEXAS: Sherylen Yoak
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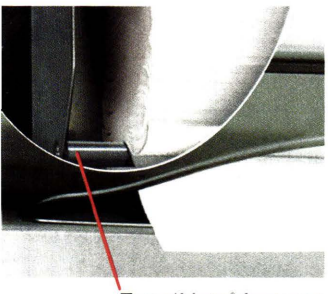
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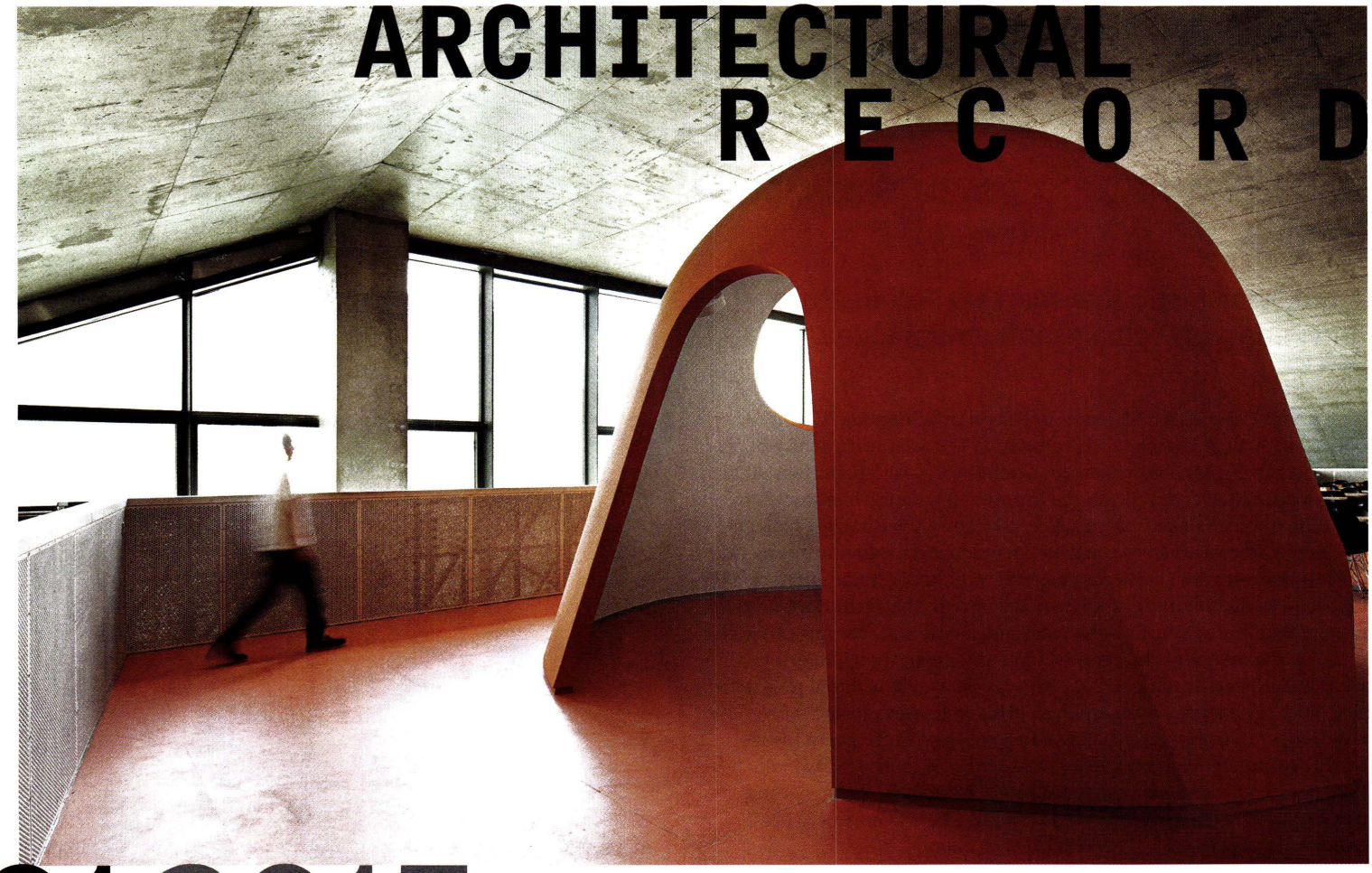


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THIS PAGE, AND ON THE COVER: GARDEN SCHOOL, BEIJING, BY OPEN ARCHITECTURE. PHOTO, THIS PAGE, BY XIA ZHI. COVER PHOTO BY SU SHENGLIANG.

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A Primer for School Design in the 21st Century

A modernist icon that married architecture and pedagogy remains influential today.

WHEN THE Crow Island Elementary School in Winnetka, Illinois opened in 1940, it launched a revolution in the architecture of schools. Designed by Eliel and Eero Saarinen, and the Chicago firm then known as Perkins, Wheeler & Will, the welcoming, low-slung, one-story brick building, with a slender, beacon-like clock tower, was hugely influential in the postwar rush to construct new schools for the incoming tide of baby boomers. The earlier 20th-century model of stately, historicist multistory school buildings, that spoke more to the aspirations of town fathers than to the comfort and teaching of children, became obsolete.

Today the design of the Crow Island school looks inevitable, but what was especially radical in its day was the way it married progressive ideas of pedagogy with architecture: rooms were scaled for children, with comparatively low 9-foot ceilings; there was pint-size furniture (much of it designed by Eero Saarinen in molded wood), L-shaped classrooms with space for a kids' workshop, and generous low windows to bring in daylight and let teachers keep an eye on children at play in the courtyards off each room.

In our special section this month, Schools of the 21st Century, we bring you a collection of schools that reflect Crow Island's values. The projects in these pages don't look like the ubiquitous one-story brick buildings spawned everywhere in the 1950s and '60s in imitation of Crow Island (which often lacked many of its special touches).

What today's best schools have in common with their forebear are designs that respond to a particular pedagogy. Wilkes Elementary School on Bainbridge Island near Seattle, by Mahlum Architects (page 92), embraces a broad spectrum of learning styles as well as the educational value of play, with transparent connections between classrooms and out to courtyards and play areas. Similarly, the expansion of the Sequoyah K-8 independent school in Pasadena, California, by the firm Fung+Blatt Architects (page 130) includes not only flexible classrooms but an easy flow to the outside, especially the individual verandas off each room. Public School 330 in Queens, New York, by Murphy, Burnham & Buttrick (page 98) is rooted in an environment far different from Wilkes or Sequoyah, a bustling urban neighborhood of recent immigrants: its extensive use of glass for views in and out gives a sense of transparency and easy orientation. What these and other progressive schools foster today is an openness that invites parents and communities to participate in the education process.



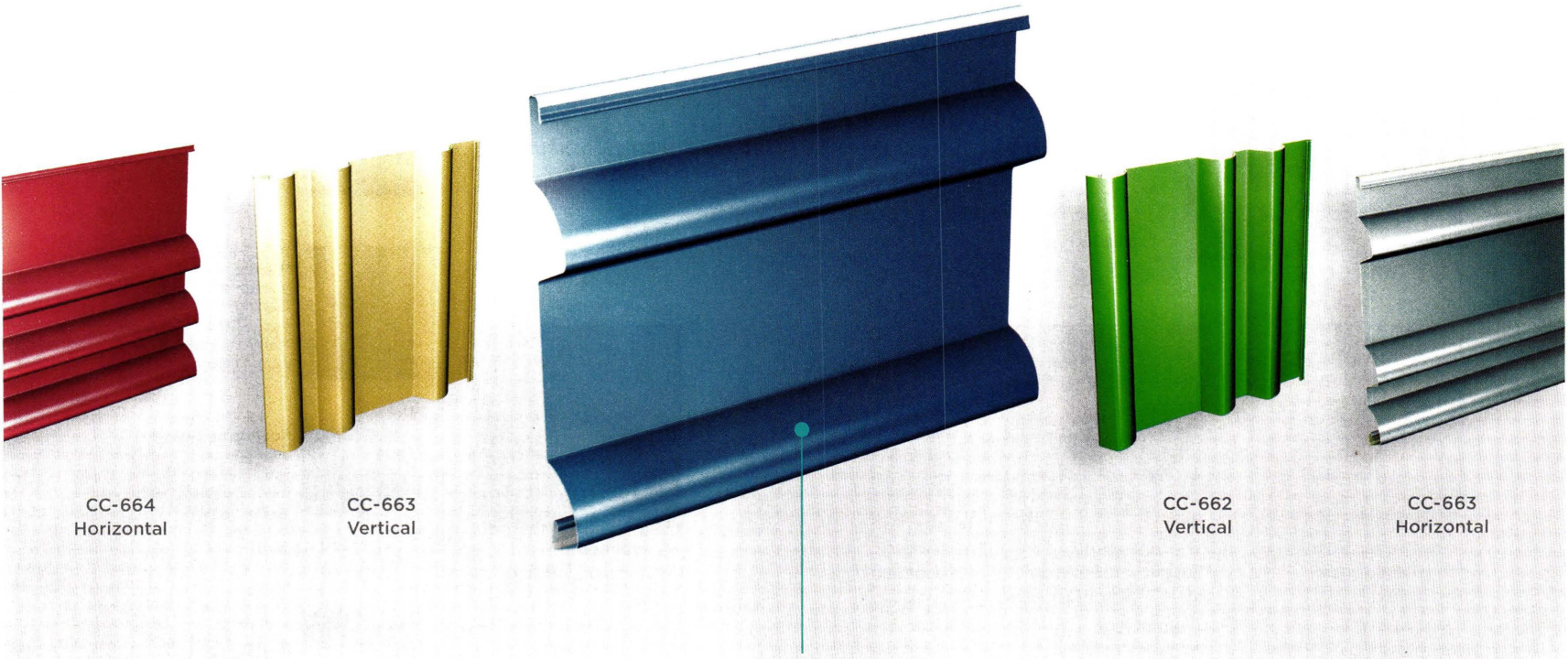
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At a much larger scale of community, we also explore in this issue the completion of two vital projects at Ground Zero in New York City: One World Trade Center, now the tallest building in the western hemisphere, and the Fulton Center, an infrastructure project proposed as part of the rebuilding after 9/11 that brings together a complex tangle of subway lines in lower Manhattan. Fulton serves a large public: 300,000 passengers a day pass under its grand, daylit vaulted interior. The design of its neighbor, One World Trade Center, was meant to respond to the desires of an even vaster community—not only of New Yorkers who lived through the attacks but Americans in general, and those in the world at large, who looked for a transcendent work of architecture in that place of horrific tragedy. Read the story by critic Sarah Williams Goldhagen, who takes the measure of this towering new landmark (page 70) and learn why she finds it comes up short. ■

Cathleen McGuigan

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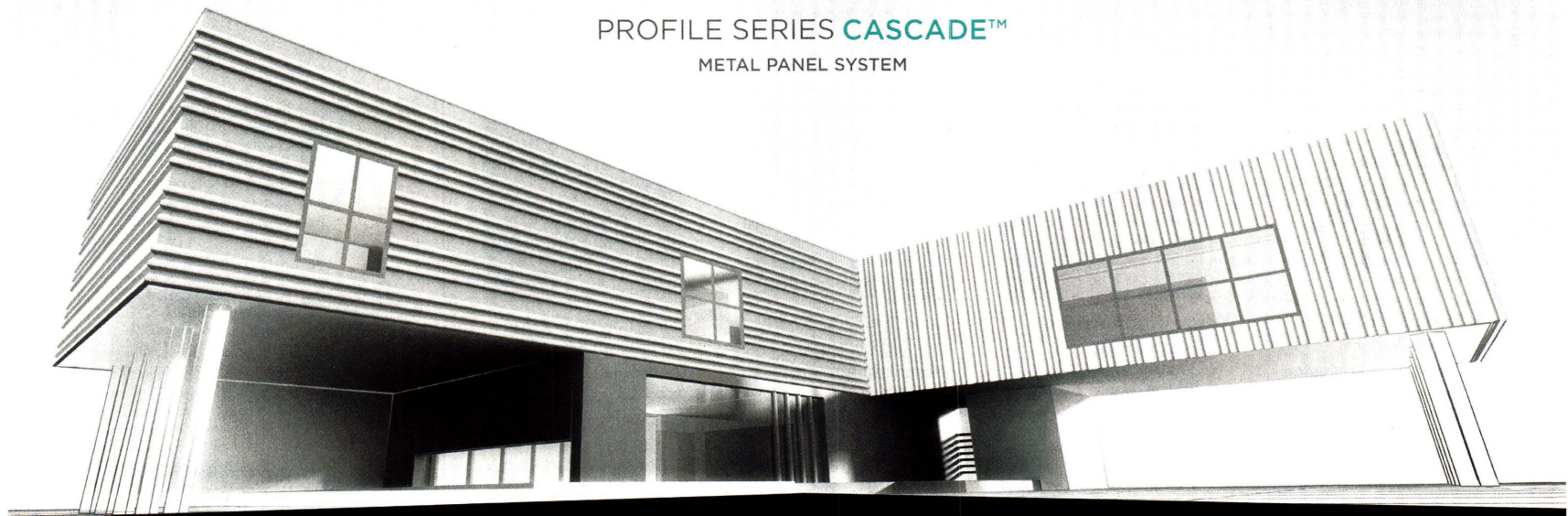
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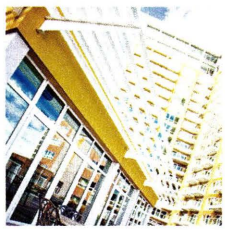


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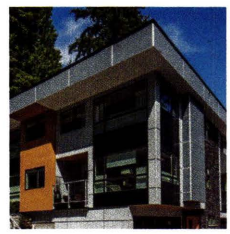
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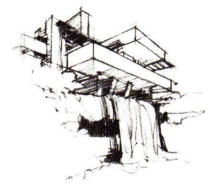


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Frank Lloyd Wright: American Icon, Architectural Master, Modern Dreamer

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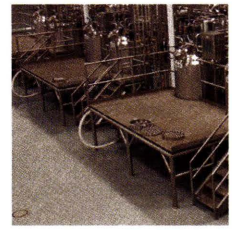


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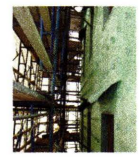
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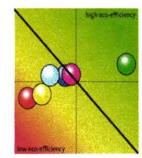
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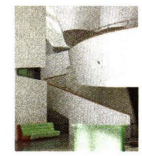
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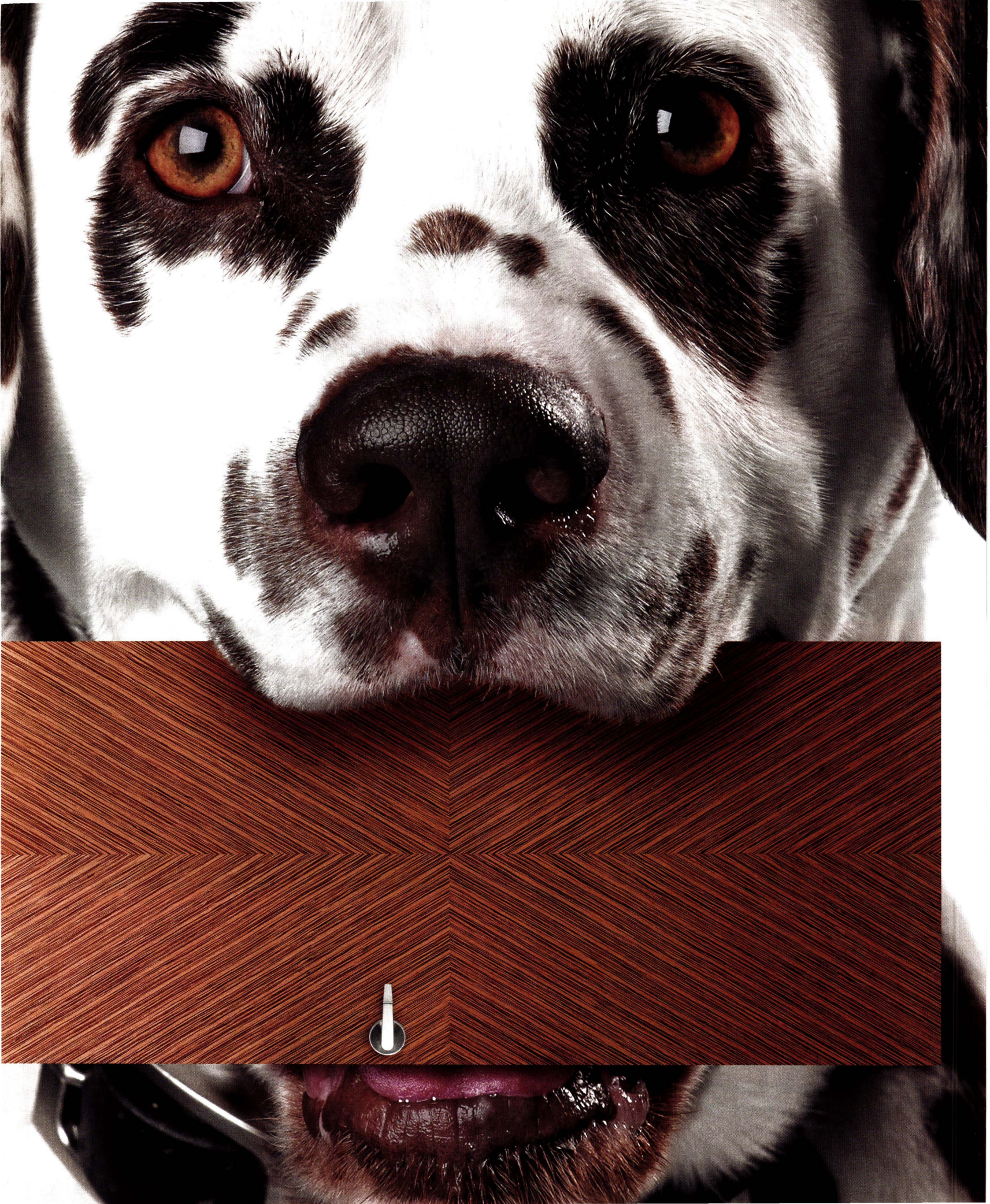
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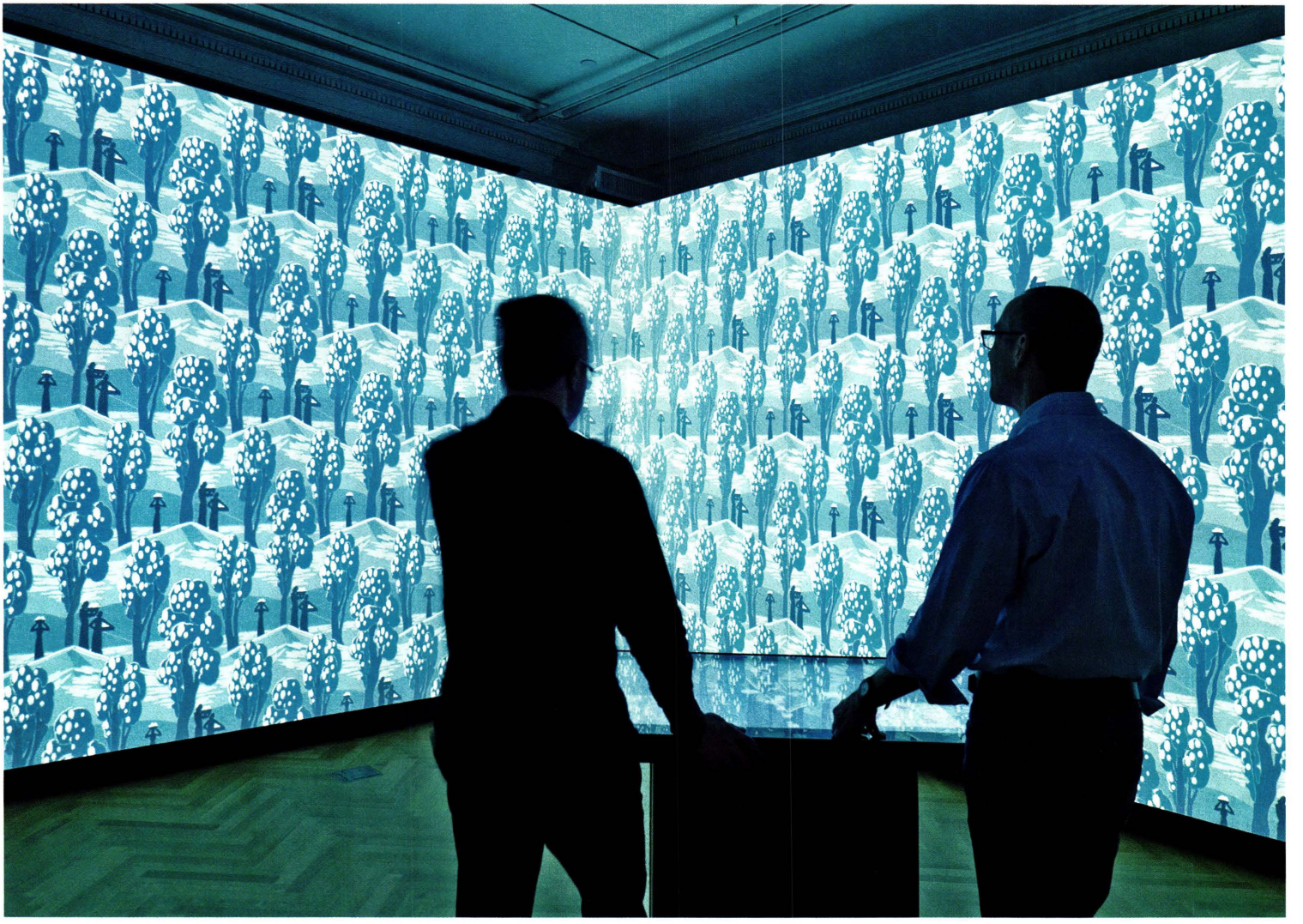
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perspective

It is not a genuinely public place. It is not free. It is not a well-conceived piece of transport infrastructure. It is a crowded and overstyled chunk of heavy engineering garnished with urban parsley. –*Rowan Moore, on a proposed pedestrian bridge over the Thames, designed by Thomas Heatherwick,* The Observer, *November 22, 2014.*

Cooper Hewitt Goes From Dowdy to Digital

BY FRED A. BERNSTEIN



PHOTOGRAPHY: © MATT FLYNN (THROUGHOUT)

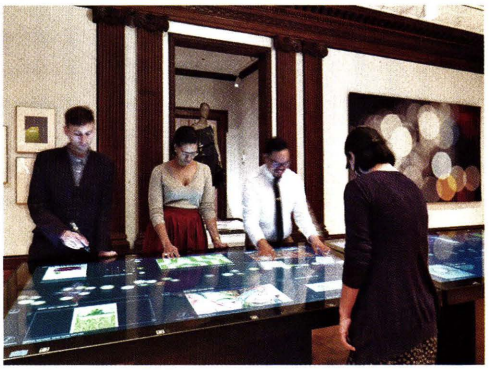
The Immersion Room on the museum's second floor features more than 200 examples of the Cooper Hewitt's collection of wallcoverings, and allows visitors to select their favorites or draw their own designs, and then project them onto the gallery walls.

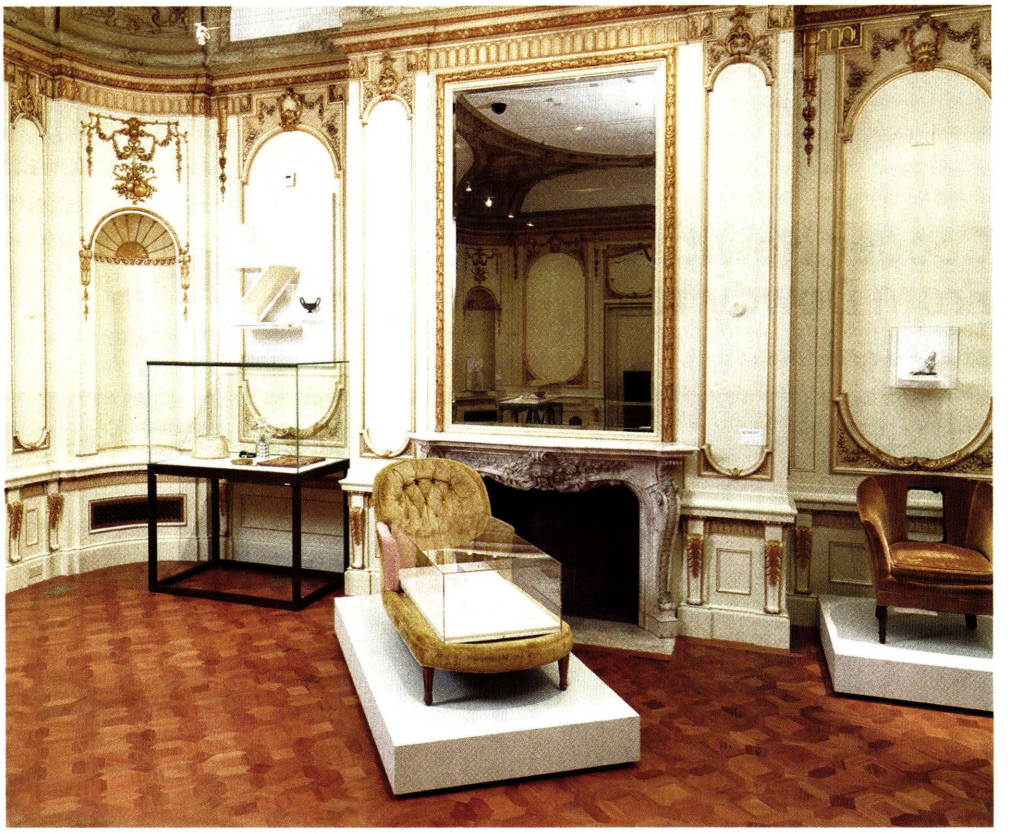
THERE ARE "super-high-definition smart tables"—glass touchscreens mounted on aluminum pedestals—throughout the newly renovated Cooper Hewitt, Smithsonian Design Museum in Manhattan. By running their fingers across the tables, visitors make shapes that are then displayed as hats, lamps, tables, vases, chairs, or buildings. During the museum's opening week, the system attracted the attention of everyone from a 4-year-old California boy to the 79-year-old architect Ricardo Scofidio. A few journalists debated whether the message—that anyone can be a designer—is the right one for a design museum to send. But slightly more troubling, for architects, is another message: that the way to design a building is to start with a shape. Here, form precedes function.

However, these are quibbles. The Cooper Hewitt is now a far better place to view design than it was before its three-year, $81 million renovation. Since 1976, the museum has occupied a spectacular Fifth Avenue mansion, built by Andrew Carnegie in 1902 and itself a decorative-arts showcase. But the American equivalent of Downton Abbey,

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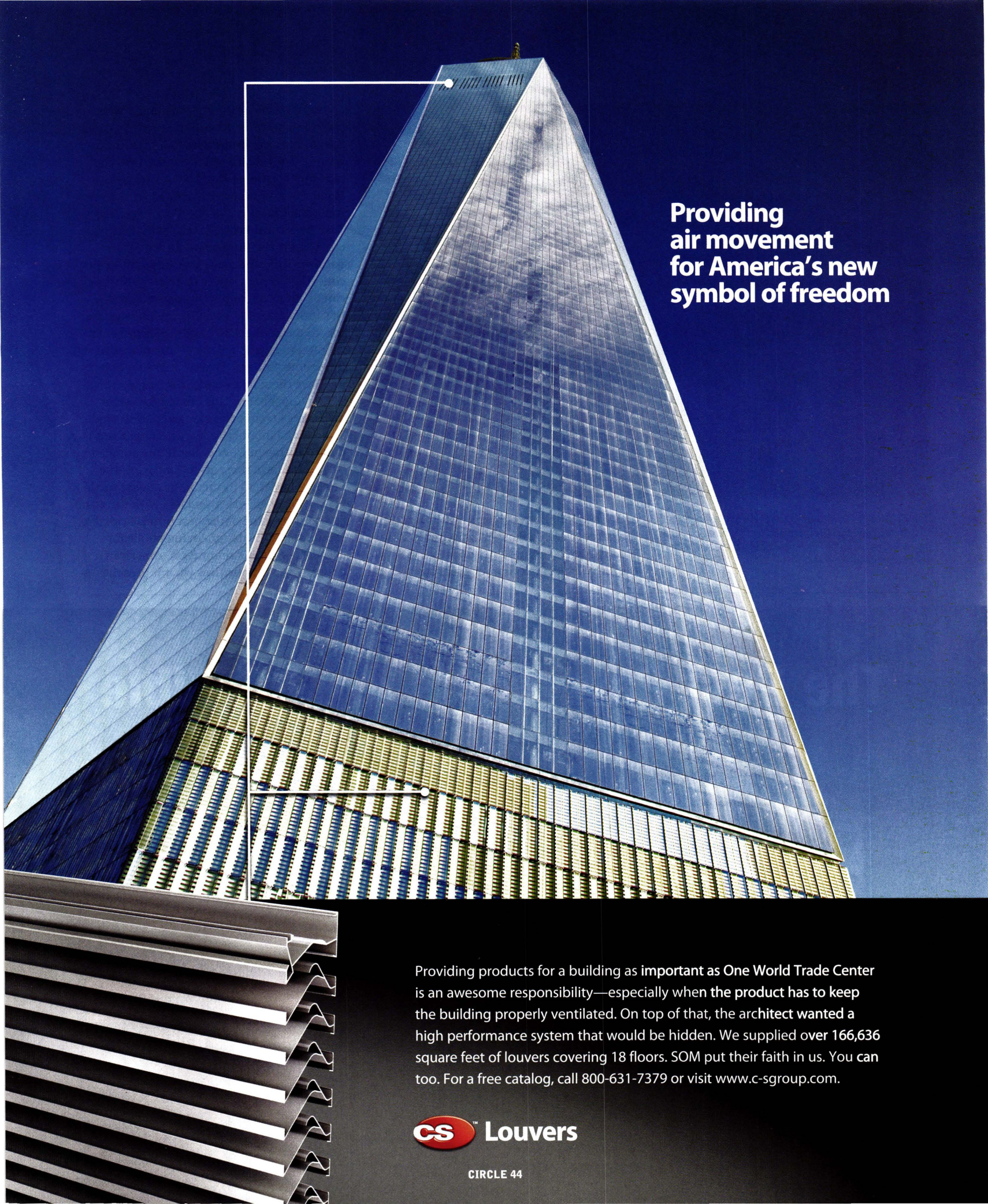




Making Design exhibits more than 350 objects from the Cooper Hewitt's collection (all except above); *Maira Kalman Selects* assembles objects from the museum, other Smithsonian collections, and the artist's home (above).

even as renovated by Hardy Holzman Pfeiffer Associates 40 years ago, wasn't a great place to exhibit new design. The galleries (landmarked spaces that cannot be altered) outwitted curators' attempts to make shows legible against their dark and ornate surfaces. For years, there was talk of creating new galleries under the lawn behind the mansion. Then Gluckman Mayner Architects came up with a more realistic plan, which involved making better use of the existing building. A former library on the third floor became a 6,000-square-foot gallery, perfect for large shows like the current *Tools: Extending Our Reach*. But the space, with characterless white walls and ceilings, feels divorced from the rest of the institution. (It doesn't help that it is reached by a somewhat utilitarian stairway, or that the windows are covered in nearly opaque screens, inducing claustrophobia.)

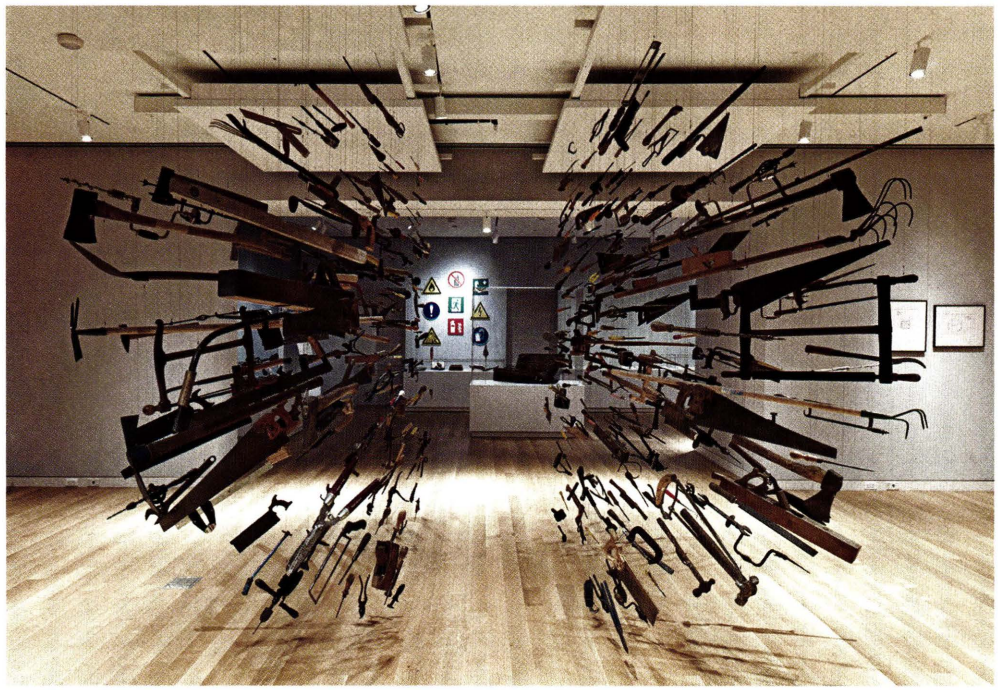
The galleries on the first and second floors are much more beautiful; the Gluckman Mayner team, headed by David Mayner, with Beyer Blinder Belle serving as preservation expert and executive architect, worked around the Gilded Age details, inserting new amenities almost invisibly. In one instance, surgically precise cuts turned a large section of wainscoted wall into a pivoting panel—a kind of secret passageway to back-of-the-house spaces. The display cases (except for those on the third floor) were designed by Diller Scofidio+Renfro (DS+R), which came to the job late but took it as seriously as any ground-up building, Scofidio said. (He recalled viewing the original Hewitt design collection at the Cooper Union during his days as a student there.) Diller Scofidio + Renfro also designed the new gift shop; a dropped ceiling with a large opening in its center turns a double-height space into an intimate room with a bit of James Turrell–like drama overhead. DS+R also created LED beacons on the Fifth Avenue side of the property



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Damián Ortega's *Controller of the Universe* features 438 suspended hand tools. It is located on the third floor, in a new 6,000-square-foot gallery, as part of the exhibition *Tools: Extending Our Reach.*

and a new portal through which visitors can enter the garden, even when the museum is closed. That garden is being subtly updated by Hood Design (with completion scheduled for July).

There was no apparent tension between the three prominent architecture firms and the 10 other designers who took part in the project. They included four winners of the museum's National Design Award: DS+R, Hood, Pentagram (which created the museum's graphic identity), and the interactive designers Local Projects. One of that firm's creations is the Immersion Room, where patterns from the museum's large wallpaper collection (always tricky to display effectively) can be projected onto two adjoining walls. Naturally, there's also a feature allowing visitors to create their own wallpaper patterns. Coming next year will be digital pens that will let visitors "collect" favorite museum objects and save them to a website for later retrieval.

The Cooper Hewitt is hoping to double attendance from pre-renovation levels, and some of the interactive features are meant to make visiting more fun. But if museumgoers these days have short attention spans, the Cooper Hewitt, to its credit, has taken the long view. Its new galleries, updated with taste and restraint by some of the best minds available, should serve the design-loving public for decades. With this renovation, America's design museum practices what it preaches. ■







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CIRCLE 66

Safdie Gets Gold

BY ANNA FIXSEN

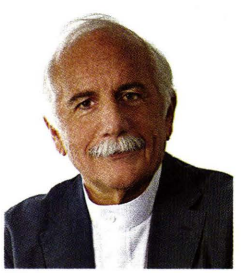
THE AMERICAN Institute of Architects (AIA) has announced Moshe Safdie and Ehrlich Architects as recipients, respectively, of its 2015 Gold Medal and Architecture Firm Award, the organization's highest honors.

"I don't want to call the award a culmination, because I am pretty active, and I want to keep going," jokes Safdie, who is celebrating his practice's 50th anniversary.

Born in 1938 in Haifa, Israel, Safdie cites the young nation's solidarity-infused atmosphere as a strong influence on his architectural approach, which is socially focused. After an apprenticeship under Louis Kahn (1971 Gold Medal recipient), Safdie designed Habitat 67 in Montreal, which, according to the architect, is "still, no doubt, my most radical achievement." Other celebrated works include Yad Vashem Holocaust History Museum in Jerusalem, the Marina Bay Sands Integrated Resort in Singapore, and the Crystal Bridges Museum of American Art in Bentonville, Arkansas.

"For me, this award is so moving because the Gold Medal is something you get from your peers," Safdie says. In his case, these peers—who wrote recommendation letters for Safdie—include Mohsen Mostafavi, Richard Rogers, and Frank Gehry, who wrote in his recommendation letter: "The world at large is a better place because of [Safdie's] work."

Safdie won out over two other finalists—Robert Venturi and Denise Scott Brown, and Eric Owen Moss. Venturi and Scott Brown were considered leading contenders after this year's rule change allowing two collaborating architects to win the medal and the controversy surrounding a bid for a retrospective Pritzker Architecture Prize for Scott Brown.





Moshe Safdie; Ehrlich Architects partners, from left: Matthew Chaney, Takashi Yanai, Steven Ehrlich, and Patricia Rhee.

Los Angeles–based Ehrlich Architects, founded by Steven Ehrlich in 1979, took home the 2015 Architecture Firm Award, which recognizes practices that have produced notable work for at least a decade. Over the last 25 years, the firm has developed its own genre of architecture—what it calls "multicultural modernism"—which delves deep into the social norms and context surrounding a project. Notable works include the John Roll U.S. Courthouse in Arizona, which features a porchlike entrance canopy; the Ahmadu Bello University Theater in Nigeria; and the Helal New Moon Residence in Dubai. The firm, which designs residential, commercial, educational, and civic projects, is currently working on its first hotel.

"We are super-humbled that our work, our collective passion, and our way of practicing has been honored in this way," says partner Takashi Yanai. "It's kind of a party here at the office today."

The AIA also announced the recipients of its other top honors: Peter Eisenman was awarded the 2015 AIA/ACSA Topaz Medallion; Rural Studio was honored with the 2015 Whitney M. Young Jr. Award; and Edward Mazria received the 2015 Kemper Award. ■

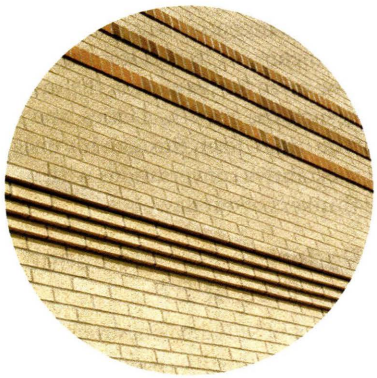
PHOTOGRAPHY: © STEPHEN KELLY (LEFT); MIRANDA BRACKETT (RIGHT)



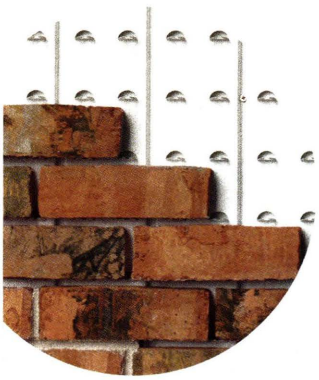
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[NEWSMAKER]

Greg Lynn

BY ZACHARY EDELSON

NO SINGLE TOOL has become more critical to architectural practice than the computer. In fewer than 30 years, CAD software and related products have become an entire industry by catering to the needs of designers. But the early years of architects' use of digital tools are little known. Greg Lynn, founder of Greg Lynn FORM and a professor at UCLA, has curated exhibitions that explore this early architectural experimentation. The exhibition, the second of three on this theme, *Archaeology of the Digital: Media and Machines*, originally at the Canadian Centre for Architecture, is now at the Yale School of Architecture (through May 1, 2015), where Lynn is the Davenport Visiting Professor.



What spurred you to conduct an *Archaeology of the Digital*?

The exhibitions are part of an archival project at the CCA. It started years ago when they acquired my Embryological House project, with its physical and digital material. That prompted a discussion of what their policy on digital material should be—the scope of their efforts and how to save the material. Another big part of the exhibition is interviews with the architects, collaborators, and technologists, to build an oral history. It's too early to write the history of digital architecture, but without this information, nobody can.

So the exhibition contains some unconventional architectural material?

We included a lot of interactive mechanical elements that people won't be used to seeing. For example, there's ONL's NSA Muscle hanging on the wall, pumping away when visitors walk up to it. The HypoSurface by dECOi Architects isn't interactive, but it's exciting to see that big robotic wall moving. Along with Karl Chu's Catastrophe Machine, these are robots that change the space and make things dynamic.

What stands out in this period of early experimentation, now 20 years old?

For me, what was amazing was how people were looking to the computer for formal or fabrication possibilities even as others looked for an architectural response to large-scale media and interactivity. For whatever reason, most architectural interest in digital technology then shifted to fabrication. Now everyone's looking to smart and interactive environments. Google and Amazon have picked up a lot of the interests of this exhibition's architects. If somebody had spent the last 15 years working on those interests, they would be insanely successful right now. A lot of the architects' collaborators ended up pivoting toward apps and the Web.

What will different generations see in this exhibition?

The projects, and the period they come from, are probably unknown to most. We received a lot of custom software and machines for interfaces from these architects. It's remarkable to see that, even 30 years ago, architects were already developing technology in-house. The myth is that architects just use or misuse software, but the reality is that certain architects were the ones who developed the technology. There was no off-the-shelf architecture software back then; it was very bespoke.

There's an ongoing conversation about how we let digital tools shape architectural designs. You've been a part of that debate from its beginnings, writing about biomorphic architecture and using calculus in designing your architecture. Does this exhibition offer some perspective on that discussion?

In the 80s there was a rich culture of intellectual exchange between historians, writers, intellectuals, outside the architecture field. It was an amazing time, and digital technology entered into that whole dialogue and really took center stage. Theorists, historians, practitioners became very interested in the computer. And then the whole bottom dropped out, and I don't know exactly why. Theorists retreated into histories of postwar modernism and stopped speculating on contemporary work. Architects stopped talking to cultural and intellectual audiences. They just started to have shoptalk about fabrication. It became very vocational. What I'm hoping for with these shows is to provoke a new generation to reengage with that material. Most historians were trained in, at least, perspective, plans, and section. They had a working knowledge of the tools, so they could write a history of it. Most historians aren't trained in these digital tools, and they have to resort to platitudes or retreat from the discussion. ■

For the complete interview, visit architecturalrecord.com/news.

noted

SelgasCano Will Design the 15th Serpentine Pavilion

The Spanish architecture firm, headed by José Selgas and Lucía Cano, will design the flexible, temporary pavilion with a multipurpose social space and a café on the Serpentine's lawn in London's Kensington Gardens. Plans are set to be revealed in February 2015.

Steven Holl to Design New Wing for Mumbai Museum

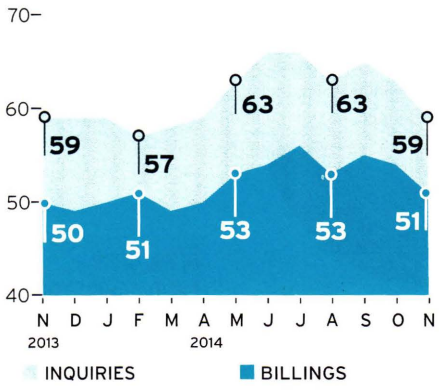
The firm was selected unanimously from eight finalists, including Zaha Hadid, OMA, and Amanda Levete, to design a new wing for the Mumbai City Museum, also known as Dr. Bhau Daji Lad Museum. Construction is expected to begin in 2015.

Charlie Rose Receives Vincent Scully Prize

The anchor and executive editor of *Charlie Rose* and coanchor of *CBS This Morning*, received the prize for "exploring the value of good design, the growth of cities, and the shape of the urban form through his insightful and substantive conversations with leading thinkers of our day."

Kohn Pedersen Fox President Paul Katz Dies at 57

Katz, president of KPF, died on November 20. He led the firm's growth as a global powerhouse in the design of large mixed-use complexes and was known for his quick mind, dry wit, and passionate advocacy for good architecture and innovative planning.



ABI Going Strong

The American Institute of Architects reports that the November Architecture Billings Index score was 50.9, down from the mark of 53.7 in October (any score above 50 indicates an increase in billings). The new-projects inquiry index was 58.8, down slightly from the 62.7 mark of the previous month.

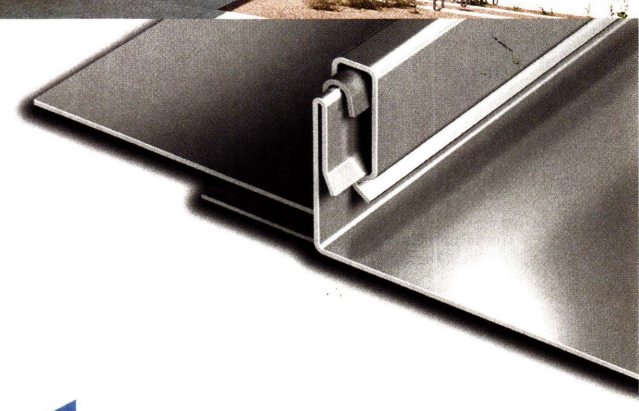
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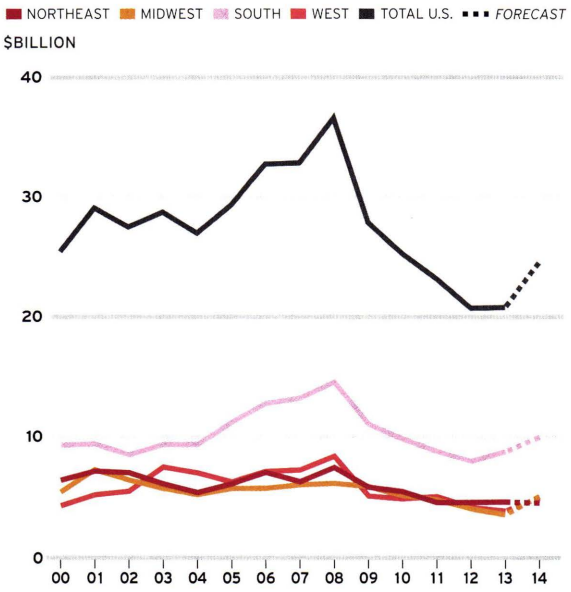
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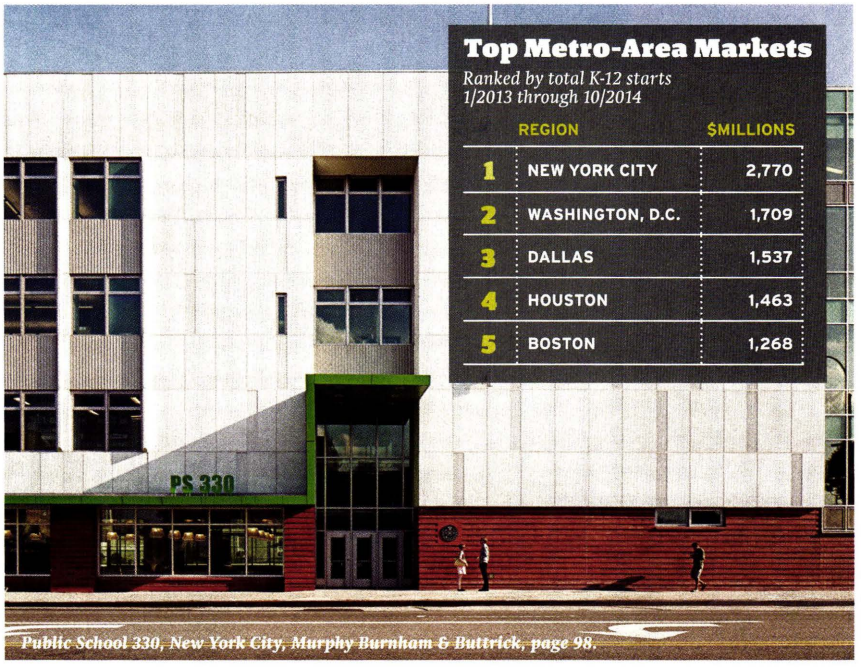
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K-12 Starts by Region

In addition to U.S. total and 2014 forecast figures





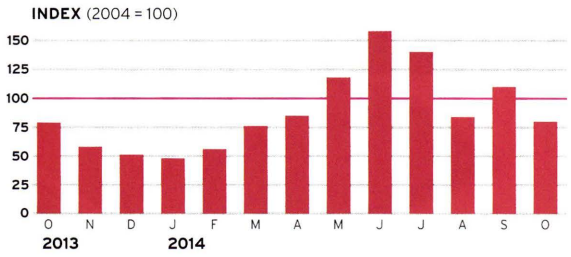
Public School 330, New York City, Murphy Burnham & Buttrick, page 98.

Top Metro-Area Markets

Ranked by total K-12 starts 1/2013 through 10/2014

	REGION	$MILLIONS
1	NEW YORK CITY	2,770
2	WASHINGTON, D.C.	1,709
3	DALLAS	1,537
4	HOUSTON	1,463
5	BOSTON	1,268

The Dodge Index for K-12 Construction 10/2013 – 10/2014



The index is based on data for K-12 construction starts that have not been seasonally adjusted. The average dollar value of projects in 2004 serves as the index baseline.

Top 5 Design Firms

Ranked by K-12 construction starts 1/2011 through 10/2014

1. **Stantec**
2. **PBK**
3. **Grimm + Parker**
4. **Corgan**
5. **Perkins+Will**

Top 5 Projects

Ranked by K-12 construction starts 1/2014 through 10/2014

$150 MILLION
PROJECT: Denton Comprehensive High School #4
ARCHITECT: VLK Architects
LOCATION: Little Elm, TX

$136 MILLION
PROJECT: David Starr Jordan High School Renovation
ARCHITECTS: NTD Architecture; PJHM Architects
LOCATION: Long Beach, CA

$130 MILLION
PROJECT: North Creek High School
ARCHITECT: Dykeman
LOCATION: Bothell, WA

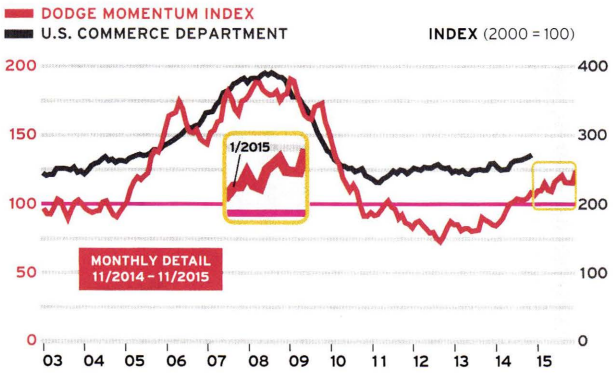
$130 MILLION
PROJECT: Winchester High School Additions and Renovations
ARCHITECT: SMMA
LOCATION: Winchester, MA

$128 MILLION
PROJECT: High School 11
ARCHITECT: PBK
LOCATION: Houston, TX

MOMENTUM INDEX CONTINUES ITS CLIMB

For two months in a row, the Dodge Momentum Index has registered gains. Now at 125.0, the index is 14% above its November 2013 mark and is at its highest level since early 2009.

The Dodge Momentum Index is a leading indicator of construction spending. The information is derived from first-issued planning reports in the Dodge Data & Analytics Reports database. The data lead the U.S. Commerce Department's nonresidential spending by a full year. In the graph to the right, the index has been shifted forward 12 months to reflect its relationship with the Commerce data.



Dodge Data & Analytics tracks projects from predesign through construction to capture hard construction costs, square footage, and other key statistical information.

PHOTOGRAPHY: © TY COLE

Sandy High School – Sandy, OR
Architect: Dull Olson Weekes Architects – Portland, OR
Photo Credit: Photo © Josh Partee 2012

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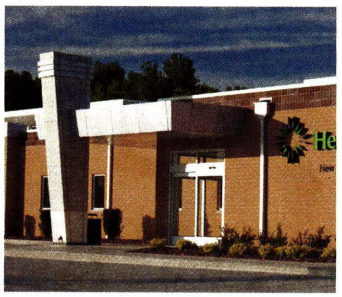
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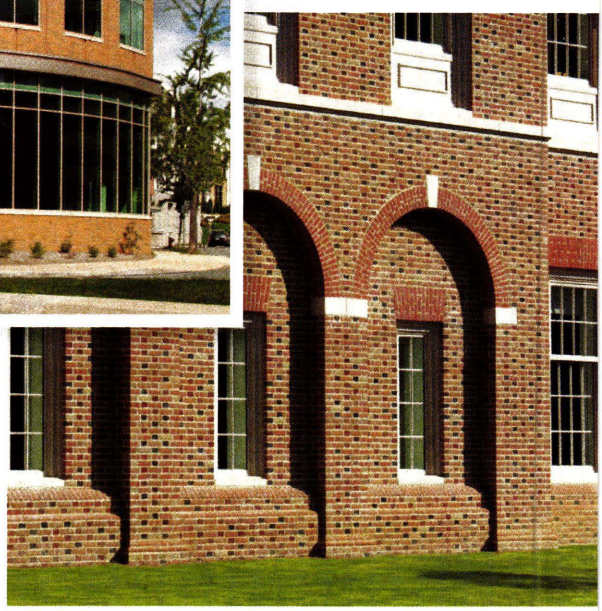
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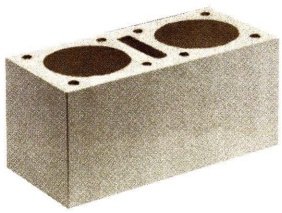
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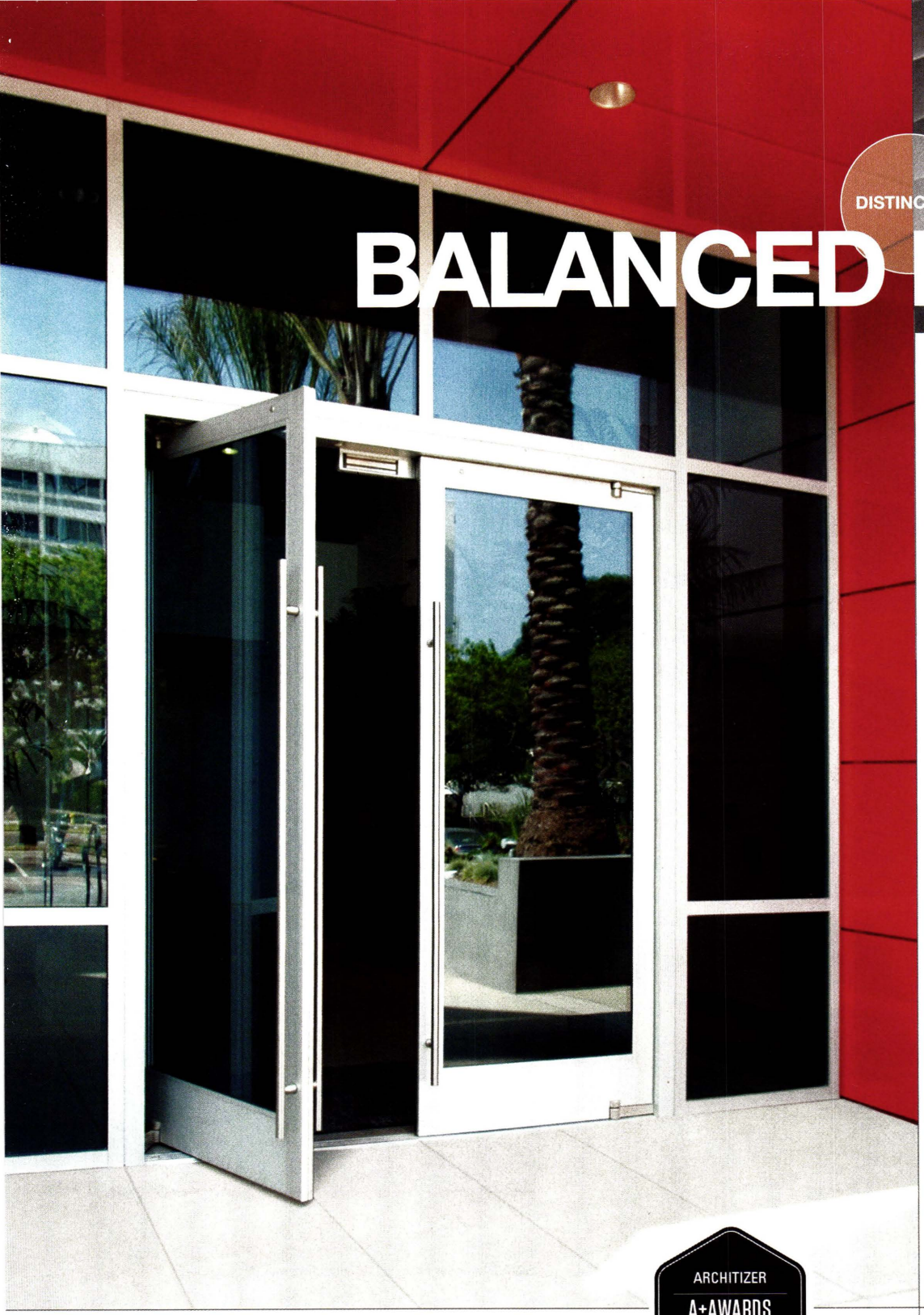

8" Double Thru-wall - 7-5/8" x 7-5/8" x 15-5/8"

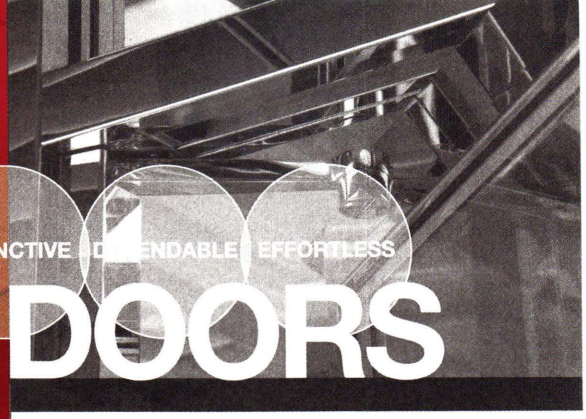
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CIRCLE 56





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CIRCLE 69

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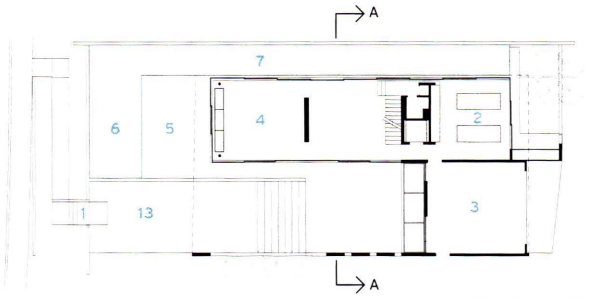
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CIRCLE 53

perspective house of the month

ARCHITECT AND DEVELOPER JONATHAN SEGAL'S CAST-IN-PLACE CONCRETE HOUSE FOR HIS FAMILY IN LA JOLLA, CALIFORNIA, BRINGS URBANITY TO THE SUBURBS. **BY DEBORAH SNOONIAN GLENN**

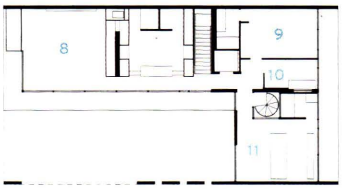




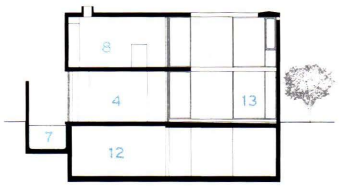
GROUND FLOOR

0 10 FT.
3 M.

1 ENTRANCE
2 KITCHEN
3 GARAGE
4 LIVING AREA
5 TERRACE
6 POOL
7 LAP POOL
8 MASTER BEDROOM
9 BEDROOM
10 LAUNDRY
11 OFFICE
12 GAME ROOM
13 OUTDOOR SPACE



SECOND FLOOR



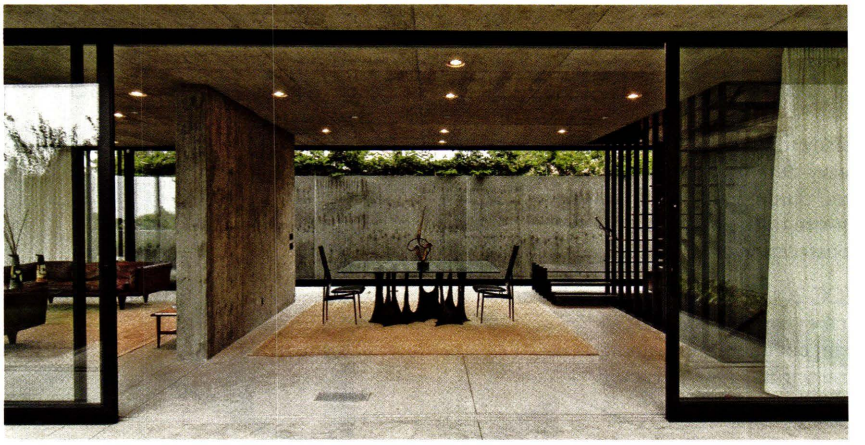
SECTION A - A

0 10 FT.
3 M.

IN TEMPERATE La Jolla, California, a narrow building lot and a desire for a generous outdoor living area gave rise to the straightforward rectilinear motifs of the 5,300-square-foot Cresta House, a three-story coastal residence designed by San Diego architect Jonathan Segal for himself and his wife, Wendy. "The house wanted to be a pure form on this site," Segal says. He conceived the cast-in-place concrete structure as an orthogonal volume, slicing and shaping rooms and functional spaces within and around it, and creating openings to maximize ocean views and daylight.

The residences in this upmarket enclave are nestled shoulder-to-shoulder. To use the 20-foot-wide lot efficiently, he shifted the house's footprint toward the back of the lot and submerged some 2,000 square feet of living space below grade. The concrete was cast using forms made of B grade plywood. "We weren't concerned with perfection; we wanted to see some texture and didn't patch the surfaces when the forms were removed," says Segal.

Now the house is the couple's oasis from the downtown office of the family's architecture and development firm. (Wendy and Jonathan's son Matthew oversaw Cresta House's construction.) The subterranean level, illuminated partially by in-floor skylights, comprises a wine cellar, workout room, and TV room with a bar, while the ground floor contains the main public spaces, and the second floor holds bedrooms and an office. "We spend most of our time in the outdoor room," says Segal, referring to the living spaces on the ground floor that open to terraces. "It feels private and serene, yet we can also hear the birds and ocean and feel a strong connection to the neighborhood when we sit out there. It's our urban house within a suburban context." ■



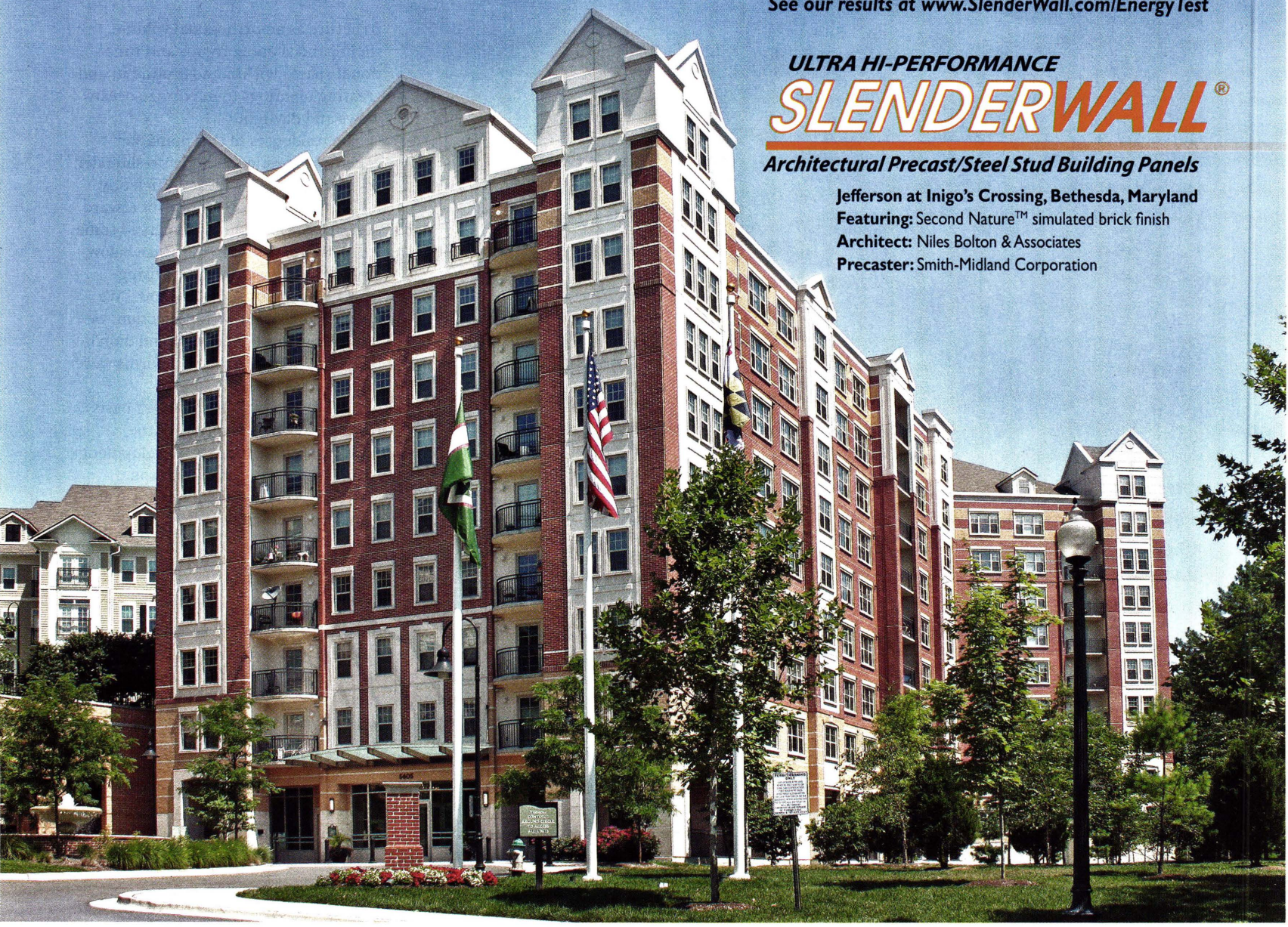
An outdoor room with a lap pool, reflecting pool, and seating areas wraps the house on the ocean-facing side (top left). The hedge-lined walkway softens the transition between the street and the entry and helps create a sense of arrival. The garage is accessible via a back alley. On the main level, sliding glass walls retract to create a seamless at-grade transition between indoors and out (above).

View additional images at architecturalrecord.com.

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CIRCLE 18

The Phantom Menace

MAD Architects' Ma Yansong has roiled the waters of Chicago's design scene with his proposal for George Lucas's museum. But does it really pose such a threat to the city's lakefront?

BY MICHAEL SORKIN

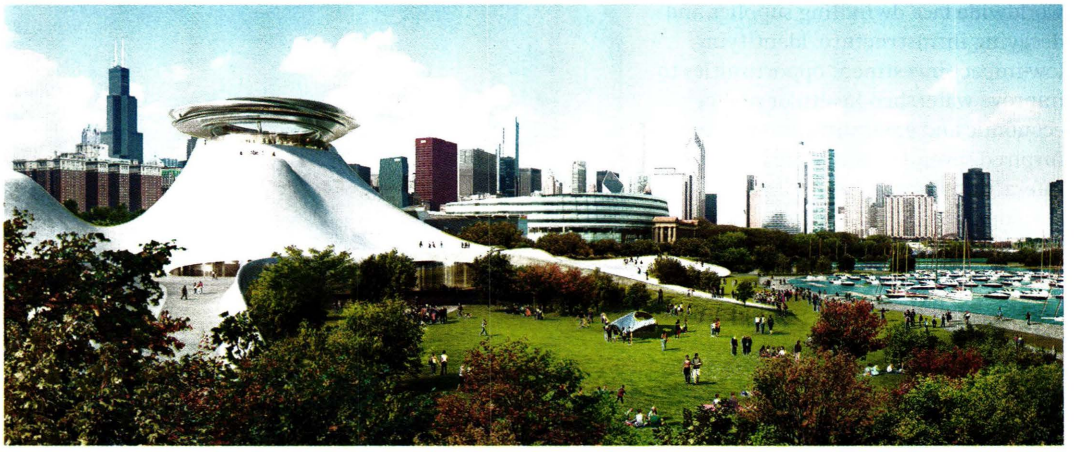
I'VE ALWAYS been partial to architectural mountains—from the Mayans to Bruno Taut—so I was delighted to see the hilly design that Beijing-based MAD Architects has proposed for the Lucas Museum of Narrative Art in Chicago. Others were less so. These included Friends of the Park, a nonprofit group, which, alarmed that the parking-lot site would not remain "open space," immediately filed a lawsuit, and Blair Kamin, the *Chicago Tribune* critic who, citing unsourced "widespread public revulsion," denounced the structure's mountainessness, blobbiness, starchitecturality, abstraction, and resemblance to (quick, a *Star Wars* image!) the "bloated" Jabba the Hutt, with his "leering, reptilian eyes." Yikes, that line between geomorphs and biomorphs can be tricky! In a subsequent article, Kamin suggested what he felt to be a better site, a few blocks away, one somewhat more constraining and linear, perhaps better able to accommodate a replica of a recumbent Carrie Fisher.

Outside the vagaries of taste, is there any merit to this spleen? Kamin observes that Lake Michigan has an "overriding horizontality." Of course, this is a quality shared with pretty much all bodies of water, not to mention the land mass extending *ad infinitum* to the lake's west. By one reading, Chicago's singularity is as an interruption in this continuous plane, a great vertical wall stretching for miles along the shore, a thin but massive membrane with flatness on either side, a continental divide. To be sure, Kamin and others are right to defend the linear park that runs between the buildings and the lake as part of Chicago's DNA. While crucial in its continuity, it is variously thin and wide along the lake and, in the case of the Lucas site, it is already filled with buildings. Some are horizontal in proportion—like the gargantuan McCormick Place, which juts criminally into the lake and is hardly an exemplar of the Prairie Style. Others in the complex, not so much, including Soldier Field with its towering Star Wars–style luxury-box addition by Wood + Zapata, though the field of play is admittedly flat.

The Lucas project—only 110 feet tall—occupies a particular space along the lake, one that can enhance continuity rather than thwart it. Not only will the still-undercooked site plan allow green space to flow around the museum, but the building sits on Burnham Harbor, facing—and eventually bridging to—Northerly Island, which awaits its own development as a park. The new museum certainly won't interrupt this flow of green frontage, and the argument that its form will detract from the morphological rhythm of the lakefront is simply specious. I say it will enhance it, offer variety, punctuation, sinuousness, and a fresh and fine architectural form in a city that has always pioneered new design. Indeed, if there's a missed opportunity, it's not on the lakeside but behind, across the barricading highway and railway tracks, where fingers of green might extend into neighborhoods now badly cut off from park and water.

And the building ain't no blob. MAD's design more strongly resembles a Frei Otto tent and such mountainous descendants as the Denver airport. These are tensile structures distinguished by simplicity and structural directness: their genius is their light weight and morphological clarity. Here, I'm with Kamin, bemused by the description of the museum as likely to be made of stone. This will either be pure computer-cut veneer (with a complex armature to hold it up) or else—if used "as it wants to be"—highly compressive and hugely thick. The thing will be *heavy*, although other possibilities abound, including ceramics *a la* space shuttle. MAD, no strangers to such mountains, can surely work it out.

Ironically, New York is in the midst of a similar drama of ambivalence over a rich man's proposed gift. Barry Diller has offered to finance his own pretty sweet-looking minimountain on a derelict pier, in Manhattan's Hudson River Park. Although both projects invoke the serious problems of depending on the plutocracy for the life of our cultural institutions, the specific Diller/Lucas comparison is flawed. Diller's gift—near the High Line (to which he and his wife Diane van Furstenberg have been generous)—is not a little self-serving. It's near their offices in an already favored part of town and comes at a time when parks in poor neighborhoods decay. Chicago urgently *wants* the Lucas collection and the economic and cultural stimulus it promises. The site—already a museum campus—makes sense. It was proposed by a well-composed committee with no particular axes to grind. And the building has the potential to be a tremendous benefit to the city. Let Lucas build it! ■



MAD's controversial design for the Lucas Museum sits on the shore of Lake Michigan with the city as a backdrop. Studio Gang will design the landscape, while VOA Associates will serve as executive architect.

IMAGE COURTESY LUCAS MUSEUM OF NARRATIVE ART

Thirst for Knowledge

Data on water conditions are feeding digital tools to solve myriad planning problems.

BY RUSSELL FORTMEYER

DIVINING RODS—really, just forked sticks—supposedly tremble when you hold them over any ground that conceals water below. Whether or not you subscribe to their seemingly magical, analog effectiveness, you might be thinking, isn't there an app for that?

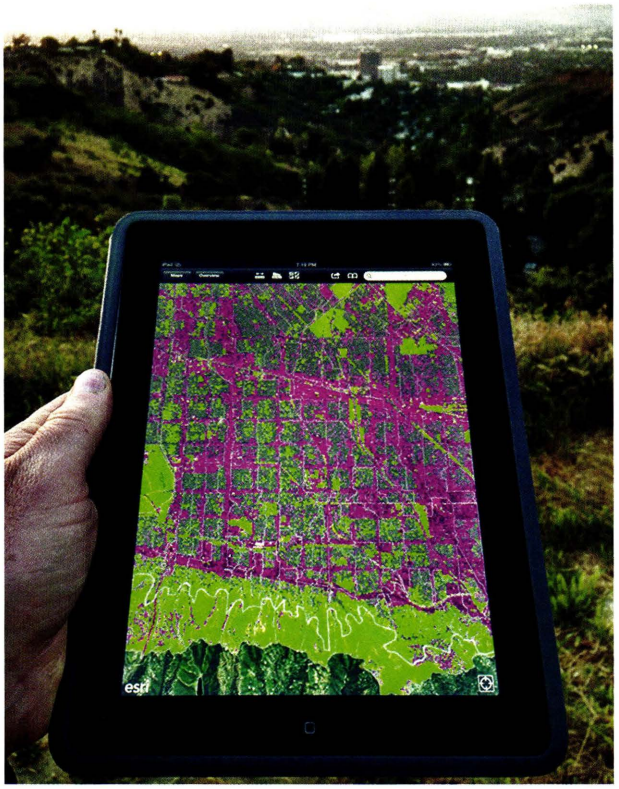
Peter Arnold is working on it. As a founding codirector of the Arid Lands Institute at Woodbury University in Burbank, California, Arnold and his colleagues have developed the proof of concept for an app—Divining LA—that will make it easier for the city to assess the impact of land-use decisions on regional watersheds.

"Cities are designed to shed stormwater off their surfaces very rapidly, but there aren't many tools available to help us examine how we could change the urban fabric to recover more of these resources," Arnold says. "How do decisions made at a small scale affect the overall hydrological network?"

The app builds on Arid Lands Institute's ongoing research into water scarcity and quality—problems that are becoming increasingly urgent as cities worldwide face dwindling supplies and decaying infrastructure. Identifying low-impact investment opportunities to improve watershed health or reduce economic and environmental risk has inspired several new tools to assess the interaction between water and development.

The Divining LA app is conceived as an open-source computational engine that makes use of a variety of public data on storm and groundwater conditions, surface porosity, topography, site contamination, and soil quality to improve design and planning choices. It also provides additional analysis of water metrics such as quality, supply, embodied energy, carbon emissions, and economic implications. The visually rich app is devised for architects, planners, landscape architects, and engineers, but is being developed with partners like the City of Los Angeles Bureau of Engineering, Perkins+Will, and AC Martin, with pro bono input from Arup (where this author is employed).

Built on a geographic information system (GIS) platform with embedded climate and land-use data, the app could conceivably permit an architect to test strategies like converting a conventional asphalt parking lot to a pervious pavement system and quickly analyze how it would affect upstream and downstream components of the watershed. Arnold says the tool was purposely created to ignore political boundaries—notorious in Southern California for blindly slicing through ecosystems to establish separate municipalities with often distinctly different policies toward treating watersheds.



Digital tools are being created to assess local water conditions, costs, and consumption. One mobile app, Divining LA (above), developed by Arid Lands Institute, uses public data to gauge the impact of development.

While Divining LA translates water concerns into potential design opportunities, other tools focus more directly on identifying risks, so that businesses can address more fundamental operations questions about the true impact of consumption in a given location. The Water Risk Monetizer, a web-based tool introduced in November by Ecolab and Trucost, calculates a risk-adjusted price for water that accounts for both its local market price and the value given anticipated scarcity for a particular watershed. Emilio Tenuta, Ecolab's vice president of corporate sustainability, says the Monetizer should help designers understand the potential for a future water crisis at a project site and advise a client on the benefits of investing early in mitigation strategies. "If we don't monetize water, it won't be managed," Tenuta says.

Less inspired by design or economic issues, the Global Water Tool of the World Business Council for Sustainable Development (WBCSD) provides an environmental footprint for water consumption at a given site. The tool, which is publicly available at no charge, was developed with the WBCSD by the global engineering company CH2M Hill to help users calculate, from simple data for freshwater and non-freshwater consumption, a range of metrics for scarcity and quality. Julie Oesterlé, the water manager for the WBCSD, says the tool is undergoing constant refinement, particularly relating to climate-change forecasts. "The use of tools is a first step in the corporate management of water challenges, which must be followed by holistic approaches and recognition it is part of a 'core business,'" Oesterlé says.

Like other tools, the Global Water Tool draws on public databases for water and sanitation for most countries. Its output includes metrics that conform to the Global Reporting Initiative's sustainability guidelines, including those for total water withdrawn, discharged, and reused. Such data typically inform annual sustainability reporting and continuous benchmarking, both of which can be useful when a building owner has multiple assets or operates in a competitive market where environmental performance plays a significant role.

Of course, there are other tools available for assessing water issues, but these three illustrate how so-called big data is empowering designers to better understand the environmental context of their projects. "Water risks cannot and should not be managed in isolation from other impacts," says Oesterlé. ■

Russell Fortmeyer leads sustainable design for the Los Angeles office of Arup. He is the coauthor, with Charles Linn, of Kinetic Architecture: Designs for Active Envelopes *(2014).*

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CIRCLE 45

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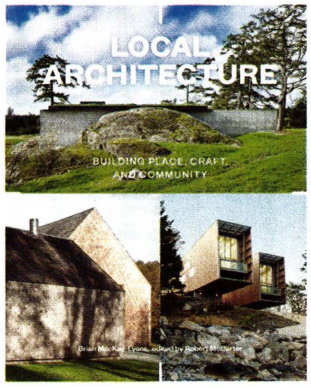
CIRCLE 50

Ghost Stories

Local Architecture: Building Place, Craft, and Community, *by Brian MacKay-Lyons, edited by Robert McCarter. Princeton Architectural Press, January 2015, 224 pages, $50.*

Reviewed by Clifford A. Pearson

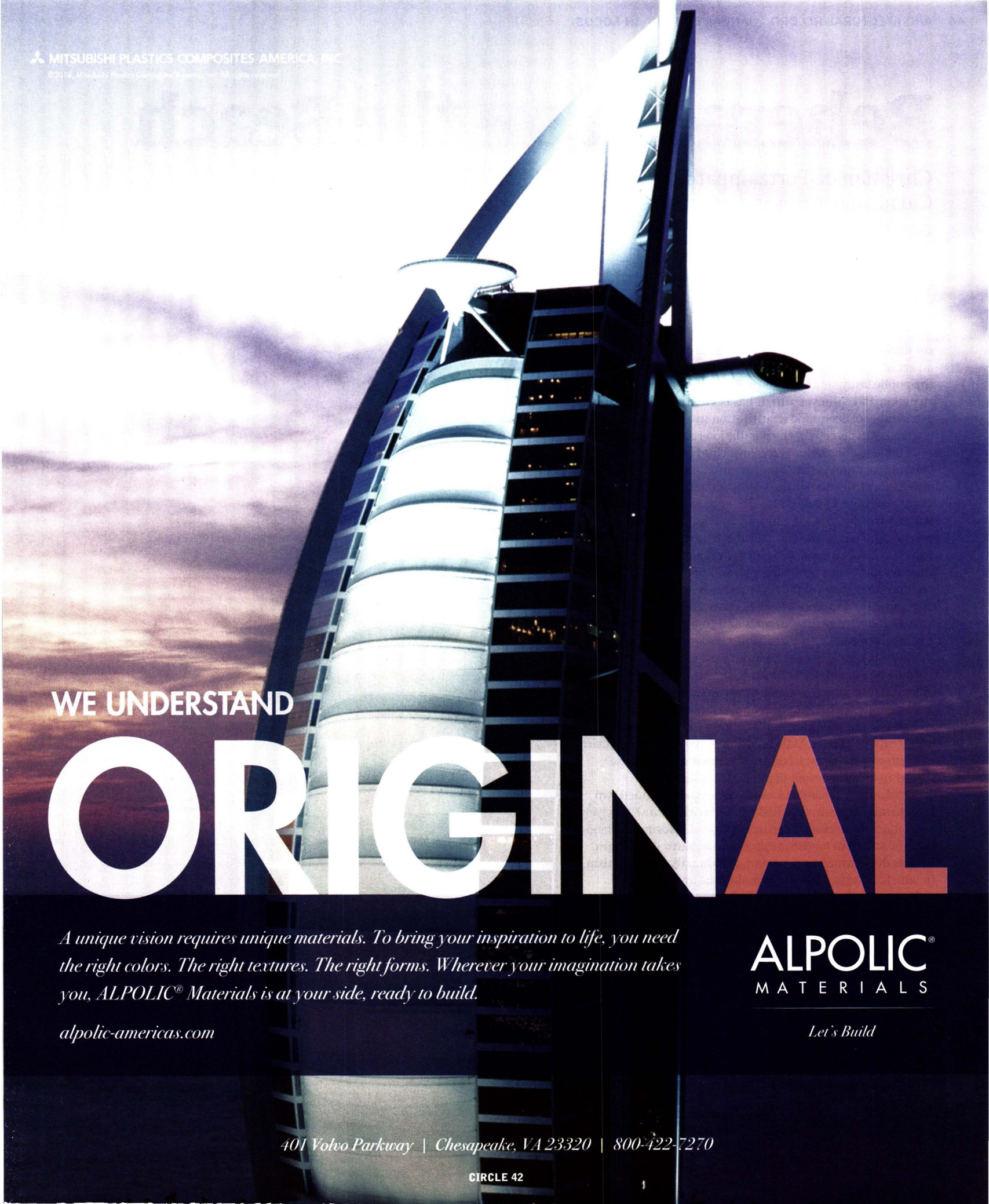
THIRTEEN TIMES during a 17-year period, architect and educator Brian MacKay-Lyons hosted a multi-day gathering of his peers, students, and fellow travelers in the ad hoc movement to reestablish architecture's roots in local soil. Held at his family farm in Lower Kingsburg, Nova Scotia, not far from where Samuel de Champlain established the first French settlement in North America in 1604, these events combined talks by an international coterie of practitioners and critics with the construction of a design-build project by MacKay-Lyons' students at Dalhousie University in Halifax. Bridging the gap between thinking and doing, the academy and the profession, these so-called Ghost Architectural Laboratories were storied affairs at which participants, braving the sometimes harsh elements of the North Atlantic, bonded over late-night chats and shared bottles of whiskey.



Local Architecture chronicles the 13th and last Ghost Lab, held in 2011. The book shows the work of the 18 architects who presented at the gathering—including Deborah Berke, Marlon Blackwell, Rick Joy, Glenn Murcutt, Patricia Patkau, Brigitte Shim, and MacKay-Lyons—as well as that of the Ghost Lab design-build interns that MacKay-Lyons oversaw in previous years. It also features the keynote talks by Kenneth Frampton and Juhani Pallasmaa, a discussion between Murcutt and Pallasmaa, and a series of essays by Robert McCarter, Peter Buchanan, Ingerid Helsing Almaas, Christine Macy, and Essy Baniassad. An introduction by Thomas Fisher provides an excellent overview of the event and identifies its key themes of reconnecting architecture to place, craft, and community. Fisher quotes MacKay-Lyons as saying, "I'm just trying to see the world whole," a clear and succinct explanation of his approach to design and life.

Though working independently and in far-flung locations, MacKay-Lyons and the other architects who participated in Ghost Lab over the years have advanced a design philosophy that responds to the peculiarities of place without being slavish to them. Climate, resources, and context inform their projects but don't limit them. These architects share an attitude and approach to their work, but aren't interested in establishing a formal movement. They aren't the Congress for the New Urbanism (CNU).

Although MacKay-Lyons and the Ghost Lab gang talk about the need to understand local building traditions and respect old ways of doing things, as do the New Urbanists, they don't historicize design. Building on old knowledge, they create architecture that is modern and forward-looking. While their periodic gatherings didn't generate the near-religious fervor that often emanates from CNU events, they seem to have had the rambling but intellectually nimble quality of a good college seminar. These architects aren't interested in writing manifestos. Instead, they put together *Local Architecture*, a book that presents a range of projects and ideas that quietly impress us with their conviction and quality. ■


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CIRCLE 42

Behemoth on the Beach

Christian de Portzamparc's massive, much-maligned Cidade das Artes is a grandiose emblem of Rio's ambitions.

BY HATTIE HARTMAN

ON FIRST impression, Rio de Janeiro's Cidade das Artes seems an act of architectural hubris and urban lunacy. Opened to the public last year after almost a decade of interrupted construction and cost overruns, it has been mired in criticism as a symbol of economic stratification in a city where an estimated 20 percent of the population resides in favelas.

The Cidade das Artes is the love child of Christian de Portzamparc and Cesar Maia, an ambitious former mayor once determined to put Rio on the global culture map. Maia's vision was for a Cidade da Musica—not Artes—modeled on Portzamparc's Cité de la Musique in Paris. And the architect was no stranger to the city: Elisabeth, his wife of more than 30 years, is a Carioca (a Rio native). When the then mayor summoned Portzamparc urgently to Rio in 2002, Maia announced that they would visit the site by helicopter, without disclosing the location. The helicopter headed west past Zona Sul's well-heeled neighborhoods and finally hovered over a vacant site at a key intersection surrounded by highways in Barra di Tijuca, almost 20 miles west of the city center.

Known colloquially as Barra (sandbar), this 10-mile stretch of beachfront masterplanned by Lúcio Costa in the 1960s has undergone explosive development. Gated condominium complexes and shopping malls cater to Rio's burgeoning upper middle classes. Maia envisioned the Cidade da Musica as a gateway to Barra, a cultural landmark amid urban sprawl in an area devoid of public facilities.

Portzamparc assembled a local team that included two structural engineers who had worked with Oscar Niemeyer and landscape architect Fernando Chacel, a former collaborator of Brazilian landscape architect Roberto Burle-Marx. He was determined to pay homage to Brazilian Modernism, in which, he says, "Structure makes the architecture."

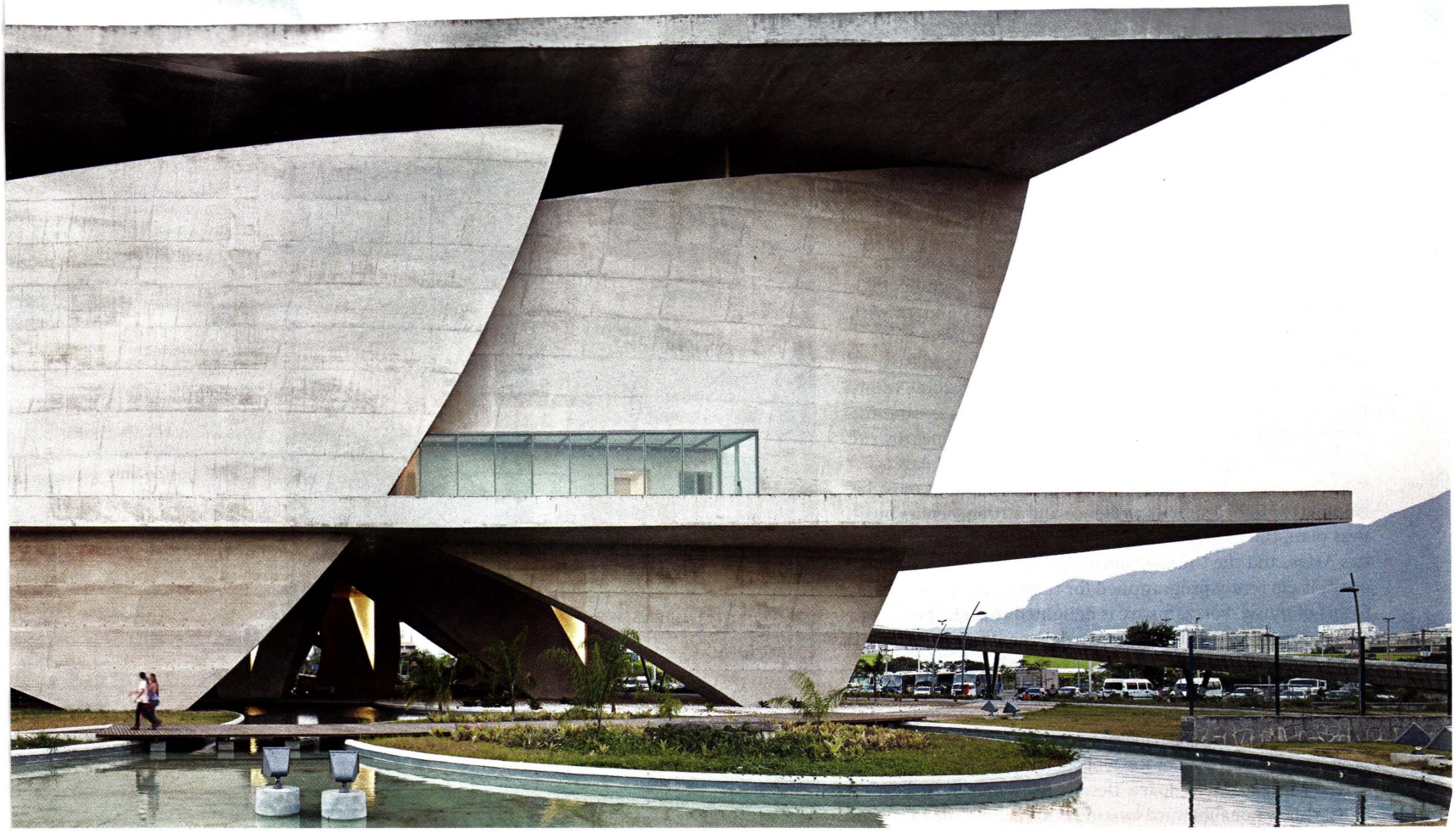
The nearly 1 million-square-foot complex is set on a concrete plinth 32 feet above the ground on which two auditoria are raised, following what Portzamparc refers to as an "open block principle," with free volumes contained by a fixed form. The Cidade is a rhomboid structure framed between two horizontal concrete planes. They enclose the two concert halls, a dance studio, movie theaters, rehearsal rooms, restaurants, and a series of ancillary facilities. For Portzamparc, the open block mimics the street by creating semi-public space linking the different programs.

In place of piloti, curving triangular "veils" of post-tensioned structural concrete which enclose the performance halls penetrate the elevated floor slab and extend to the ground to support the building. Lifting the building off the



PHOTOGRAPHY: [illegible]SON KON (RIGHT); HUFTON+CROW (BELOW)





ABOVE THE FRAY
The raised floor plate of Christian de Portzamparc's Cidade das Artes lifts its public spaces higher than a busy traffic interchange in Rio's sprawling Barra district, affording views to the sea (left) and mountains. Sail-like sheets of structural concrete (below) enclose theaters and support the elevated spaces.



ground creates views of the sea and the surrounding mountains, and distance from the swirling traffic below.

The project brief called for a philharmonic concert hall that could also be adapted for opera, as well as a second, smaller auditorium for chamber music. These technically complex spaces were delivered to a very high standard with the collaboration of acoustician Albert Yaying Xu of Paris-based Xu-Acoustique. But Maia's successor, Eduardo Pais, halted construction on the Cidade da Musica in 2009, wanting to disassociate himself from his predecessor's grandiose scheme. Only when Rio won the Olympics, and a nearby site in Barra was earmarked for the Olympic Park, did Pais acknowledge that the neighborhood's white elephant must be completed. To broaden its audience and strengthen its business plan, the Cidade da Musica was rebranded as the Cidade das Artes, and the Grande Sala designed for symphony and opera is currently programmed for theater, dance, and all forms of music. Portzamparc is delighted that the building is at last operational, but notes, "We delivered a Ferrari concert hall which the client is using as a conventional car."

The building is a thoughtful response to the original brief, though it is overscaled and overly complex. Portzamparc has designed a forbidding performing-arts complex of Piranesian proportions in an area of Rio where shopping malls are the closest thing to public space. Despite its high-tech concert halls, this is not a forward-looking building. It fails to address



FLOTATION DEVICE Within the Cidade's single structural frame, separate volumes surround different components of the program, and flow open-air public spaces around them (above). Floating columns (left) distribute the weight of the roof to the enclosed spaces via transfer beams, one of which incorporates a small terrace on which musicians can have a break from the adjacent rehearsal room.

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SMOOTH OPERATOR Portzamparc's firm worked closely with a local team that assured remarkably high-quality concrete work. The open decks inside the imposing structure were designed to provide a rare public space (above) in the sprawling neighborhood. Albert Yaying Xu of Paris-based Xu-Acoustique worked with the architects to design the performance spaces and a rehearsal studio (left).

critical 21st-century realities such as sustainability or socially inclusive programming. Conceived as permeable by the surrounding city, the entire site is fenced for security.

Yet the very generosity of the building's elevated veranda, with its stunning views of this rapidly growing area of Rio, may be its saving grace. It has already become a popular setting for television advertisements and commercial photography: Brazil's November *Vogue* featured several fashion spreads with the Cidade das Artes as a backdrop. If supported by wide-ranging programming that draws on Rio's wealth of cultural diversity, the building could evolve into a vibrant venue and attract many different audiences. One can easily envision a samba school rehearsing in the building's plaza-like open spaces. With the right programming, Cidade could serve the city that its architecture keeps at a distance. ■

Hattie Hartman is an editor at The Architects' Journal *in London.*

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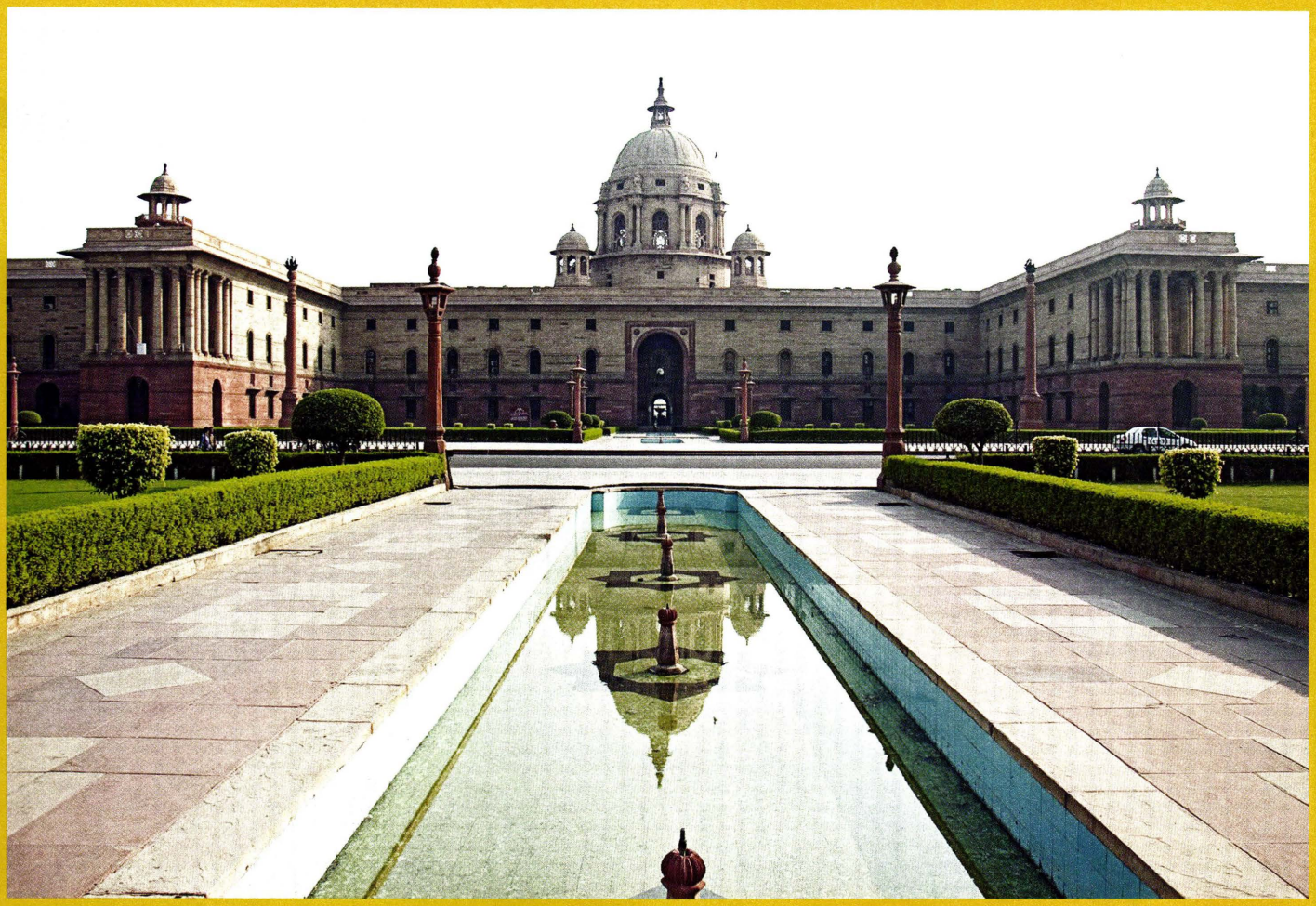
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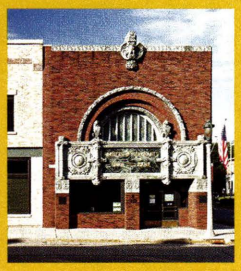
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The answer to the November issue's Guess the Architect is Louis Sullivan, who designed the Farmers & Merchants Union Bank in Columbus, Wisconsin (1919–20), one of a series of this building type executed late in his career. For more details, including the winner, go to archrecord.com.

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ONE POUR FILLS MORE THAN FOUR (SIX TO BE EXACT).

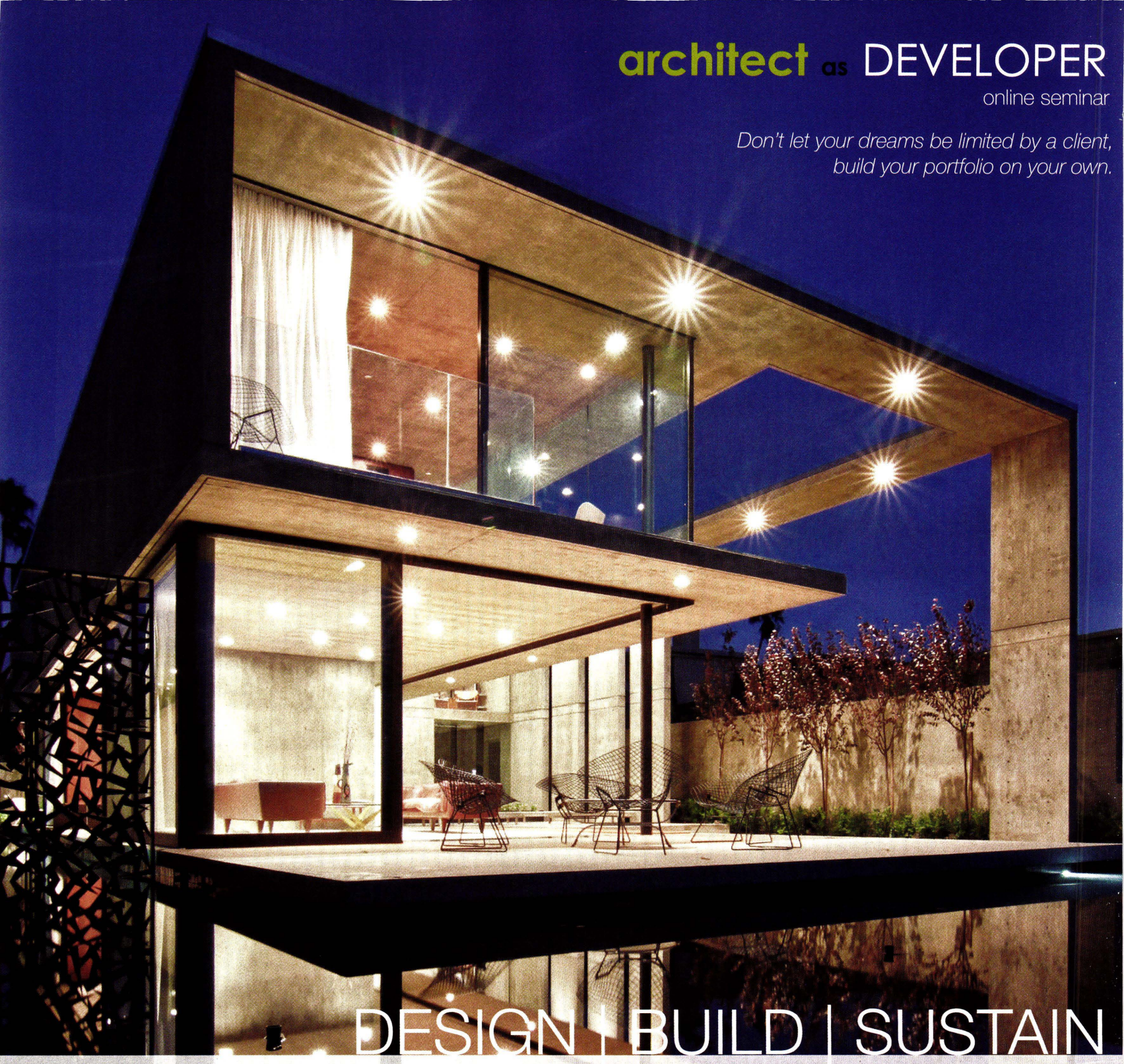




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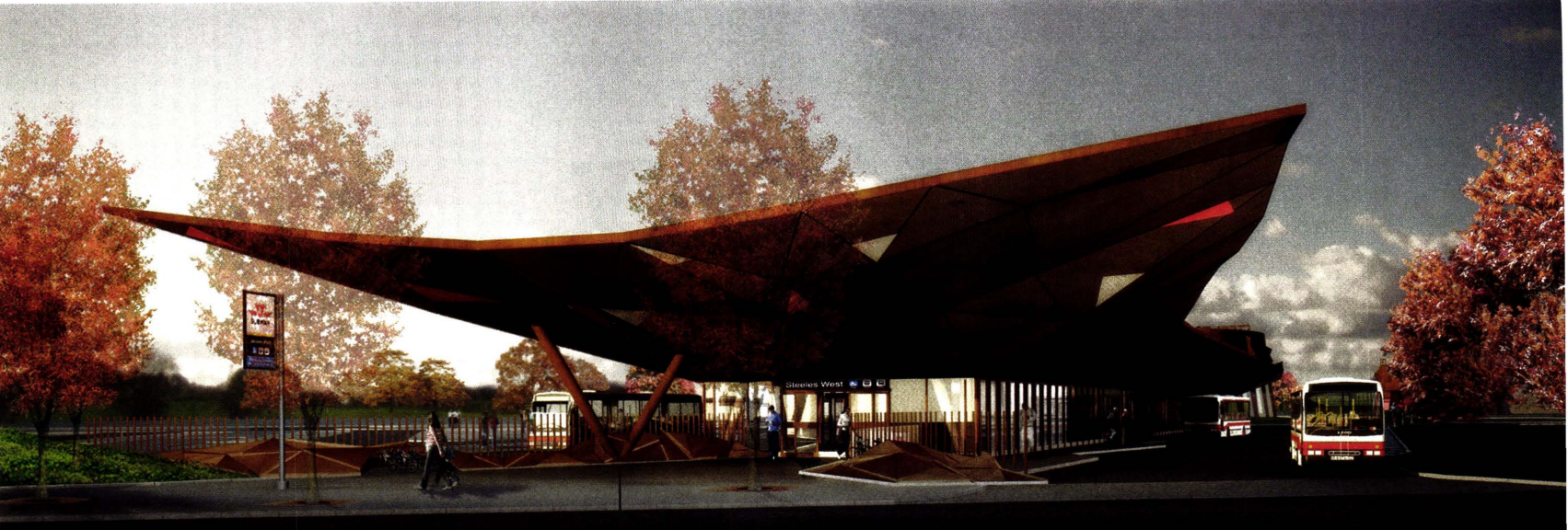
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Crowning Glory

Giancarlo Mazzanti designs a school in Colombia as both a beacon and a catalyst for an overlooked neighborhood.

BY ANNA FIXSEN

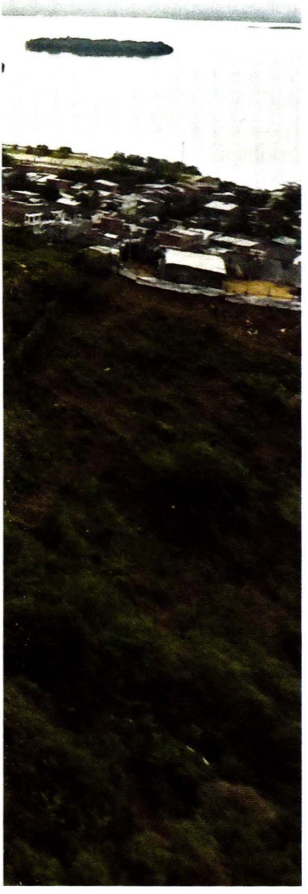
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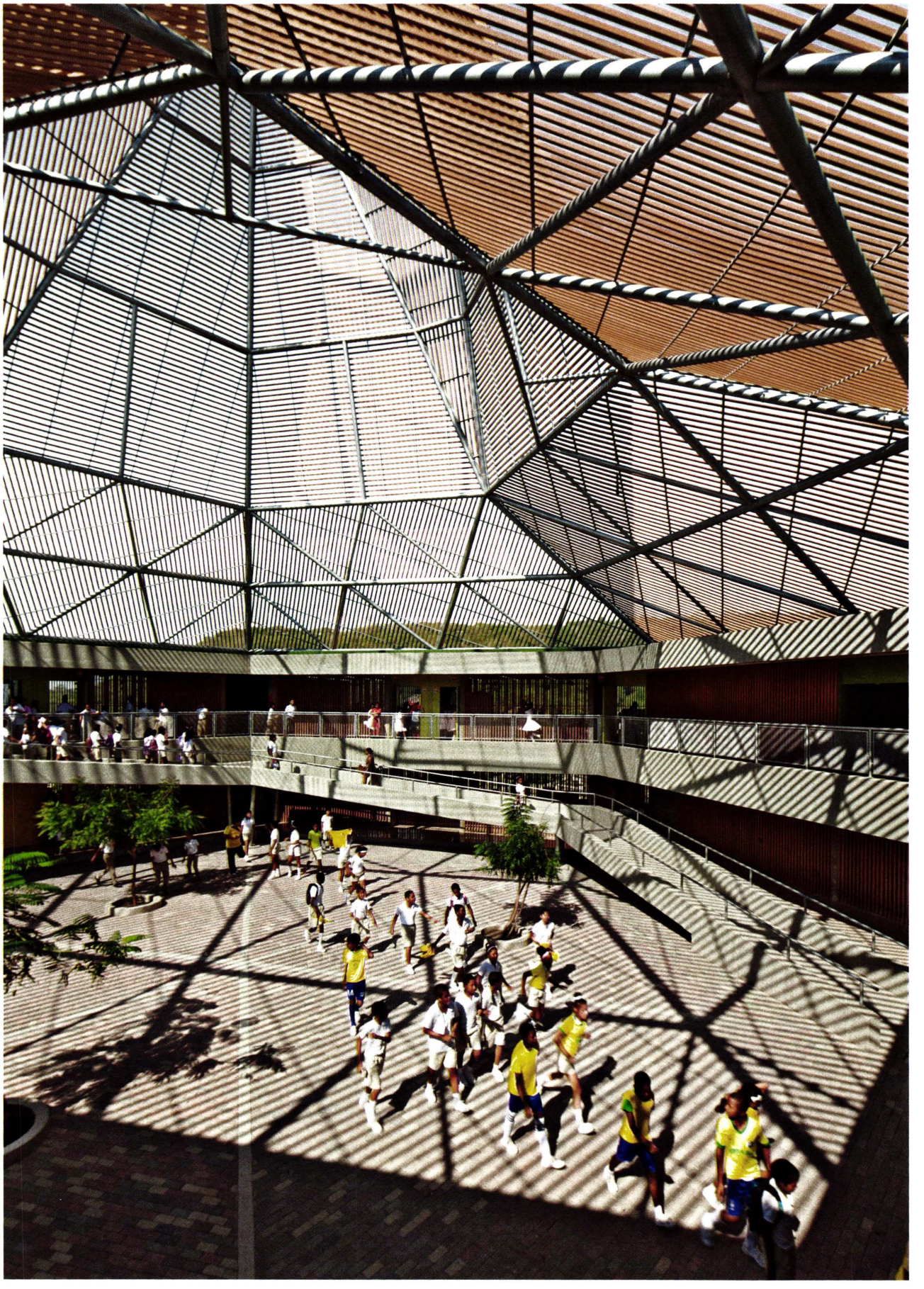


Cartegena, Colombia, according to a *Lonely Planet* entry, is the "undisputed queen of the Caribbean coast." Its azure beaches attract droves of tourists, and its colonial-era buildings and cobblestone lanes served as muse to novelist Gabriel García Márquez. But just a 10-minute drive from this idyll, an expansive slum blankets the hill of Lomas del Peyé. Children there, isolated from city resources and unable to afford transportation to the nearest school, attend classes sporadically, if at all.

Fundación Pies Descalzos, a nonprofit founded in 1997 by Colombian pop singer Shakira to empower underserved children, chose Bogotá-based architect Giancarlo Mazzanti to design a school for this community. "Sometimes institutions will build projects that do not improve the environment," says Juan Andres Lemus, a director at Pies Descalzos. "To prevent that, we went to Giancarlo. We wanted this kind of project—something that would make the neighborhood proud."

In March, the school opened with 893 students; it now accommodates 1,400 and





MADE IN THE SHADE
The architect conceived the Lomas del Peyé school (left) as a shaded greenhouse. A dramatic screen covers the central courtyard (right), providing a respite from the scorching Caribbean temperatures. Tropical plants dot the interior courtyard and a winding concrete ramp provides circulation among the school's 49 classrooms.



HAT TRICK From above, the school takes on a honeycomb appearance (left). This unique shape, like a mosaic, allows for future hexagons to be added as the school expands. From afar, the sombrero-like profile is visible from the surrounding community (below) to the wealthy tourist-filled segments of Cartagena.

has a capacity for 1,700. Its cafeteria dishes up nearly 1,000 lunches daily, and the facilities are accessible to the surrounding community of 34,000 people.

Initially, construction proved challenging. Basic infrastructure, including gas, electricity, and paved roads, was minimal, and building materials repeatedly disappeared from the construction site. But as the community saw the project take shape, this changed. "If the school becomes a center for the whole community, the people start thinking of the school as their own property, and they care about it," says Lemus.

Built on the crest of the hill, the school is composed of three hexagonal concrete structures, which interlock in an Escher-like tessellation. A conical screen covers the central section like the crown of a hat, with the school spreading out around it like a brim. The screen, made from a wood composite, shades the inner courtyards, where temperatures can soar well above 100 degrees Fahrenheit. Its form can be seen throughout Lomas del Peyé and by the wealthier neighborhoods beyond. "We wanted to bring visibility to



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OPEN ENROLLMENT Inaugurated in March, the school now accommodates 1,400 students. Before, many of them had to travel outside the Lomas del Peyé neighborhood to get to the nearest school. In addition to a preschool, middle school, and high school, the facility provides programming for community members. The simple classrooms have slatted walls to allow for cooling and views outside.



this side of the city," says Mazzanti.

The school's 49 classrooms, organized around the perimeter of the three hexagons, are accessible from the courtyards by winding concrete ramps. The two larger volumes hold the middle- and high school classrooms; the smallest contains a preschool.

While the classrooms are made from concrete block, slatted wood walls and large windows let in plenty of daylight and airflow, and provide views to the surrounding neighborhood and sea. Three volumes, like nodes, at each of the hexagonal sub-schools house specialty classrooms—a music room, an auditorium, and an art studio—and are cantilevered over the hillside.

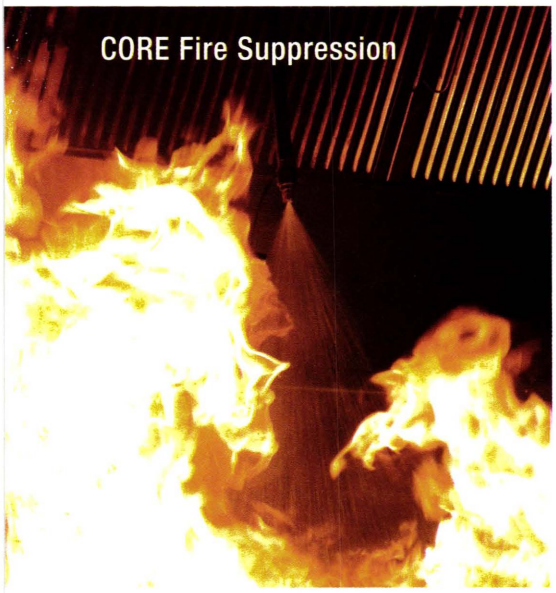
Crucial to the design was integrating Pies Descalzos' Open Door School Strategy—a policy by which the school also serves as a resource for the greater community. Locals can access an entrance just west of the primary student portal to use the library and to attend classes on nutrition, health, and professional development. Though the foundation donated the school to the local government, it will oversee these programs. A large athletic field sits flush against the complex for both students and the community to use for pickup games of soccer. "I like this school, because we can be proud of the community," says Mazzanti. "It's a symbol of change in the neighborhood." ■

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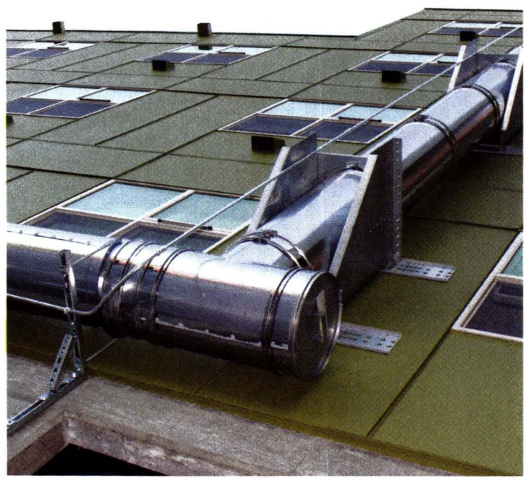
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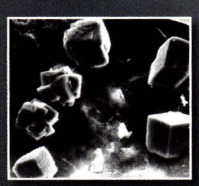
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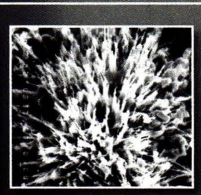




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CIRCLE 38

Cool for School

Recent products for the education market are keeping youths—from kindergartners to teens—safe, engaged, clean, and comfortable.

By Sheila Kim



EZH2O New Models

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The Ant Farm and Weeping Willow

Tapped to reimagine playground structures for a new company called Free Play, New York–based LTL Architects delivered four sensory experiences. One, the Ant Farm (left) evokes the classic cross section of tunnels by using red tubes suspended within a clear polycarbonate structure; a second, Weeping Willow (right) presents a dense canopy of yellow ropes to climb up, move through, or swing on. freeplayplaygrounds.com **CIRCLE 207**



Contemporary Toddler Kitchen, Washer Dryer

A 110-year-old manufacturer of furniture for early learning, Whitney Brothers creates Greenguard Gold Certified wood pieces that range from storage and seating to imaginative play. The latter includes a new kitchen combo and a washer/dryer unit, both composed of birch laminate with a nontoxic natural finish and made in the U.S. whitneybros.com **CIRCLE 210**



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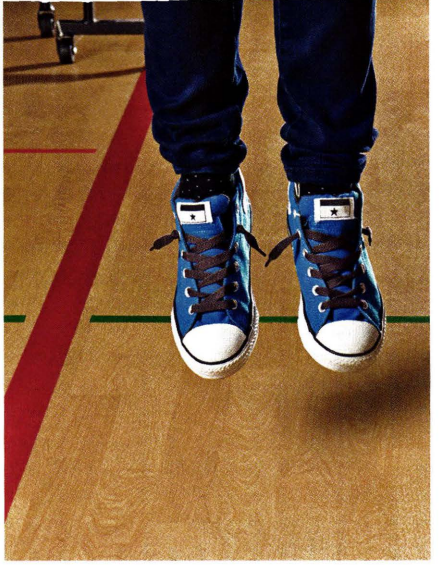
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products briefs

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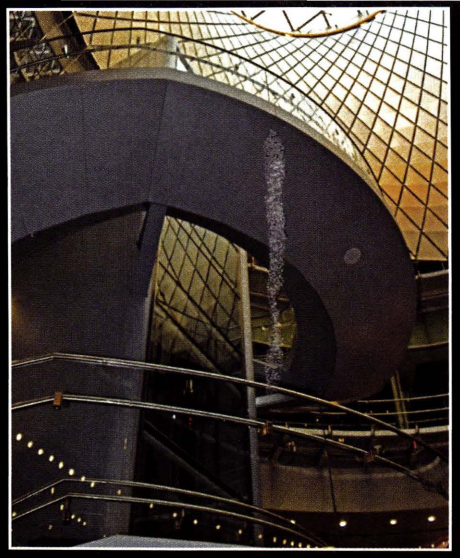


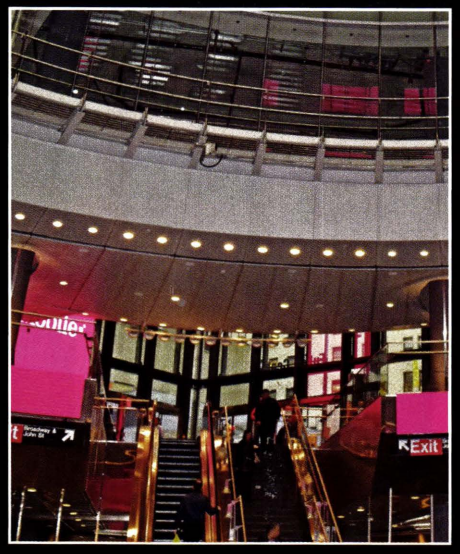


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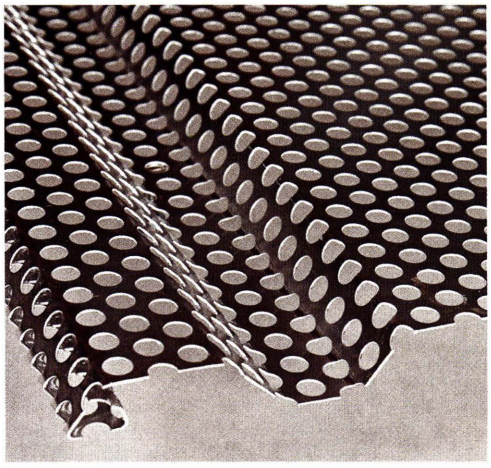
CIRCLE 55

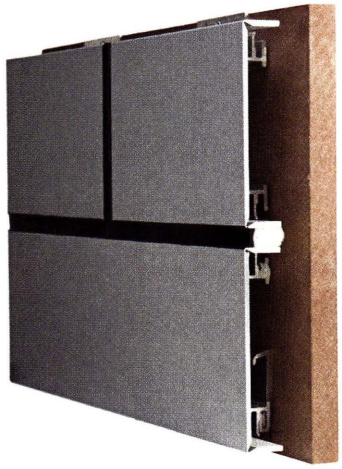
products exterior cladding

A MEDLEY OF HIGH-PERFORMING MATERIALS, FROM STONE AND METAL TO CERAMIC AND WOOD, IS BEAUTIFYING FACADES. **BY SHEILA KIM**













Adair Marble Overlay

Arriscraft arriscraft.com

Suitable for both interior and exterior applications, this thin limestone cladding adheres to a solid substrate, making it easy to install. The quarried stone units are 2⅛" wide, in random lengths ranging from 4" to 23", and installed with dry joints, creating dramatic vertical or horizontal stack designs. Adair is offered in a blue-gray color with naturally occurring variations. CIRCLE 200

Reynobond NC

Alcoa Architectural Products reynobond.com

Alcoa has launched a new panel product that features the same flatness and stiffness as its Reynobond aluminum composite material (ACM), but with increased recyclability and dent resistance. Called Reynobond NC, it utilizes two 1/16" thick sheets of coil-coated aluminum bonded to each other rather than the polyethylene or mineral core used in ACM units. NC is offered in the full range of Alcoa's paint finishes. CIRCLE 205

Pixel

Lea Ceramiche ceramichelea.it

HOK's product design team collaborated with Italian tile manufacturer Lea to create this thin, laminated porcelain line in a palette inspired by the Italian landscape and seaside. Previewed last spring and now officially on the market, it is usable both indoors and out—even as exterior cladding. The ¼"-thick tiles come in three sizes: 5" x 19", 19" x 39", and the large-format 39" x 118". CIRCLE 201

Kebony Wood Cladding

Kebony kebony.com

Recently completed by architects Walker and Martin, a pair of contemporary beach houses in East Sussex, England, utilizes Kebony wood cladding as a sustainable alternative to tropical hardwoods. Kebony technology impregnates softwoods with a bio-based liquid that permanently modifies their cell structures to provide high performance. The resulting nontoxic material is low-maintenance and warps 40% to 60% less in water. CIRCLE 204

Perforated UNA-CLAD Delta Concealed Fastener Panels

Firestone Building Products firestonebpco.com

New perforated versions of UNA-CLAD Delta concealed-fastener panels can add interest to interior or exterior designs. Seven patterns—each with a different combination of hole diameters and spacing—provide an open area of 10% to 40%. The panels come in 11 profiles and are constructed of aluminum (steel is also offered for interior use only). CIRCLE 202

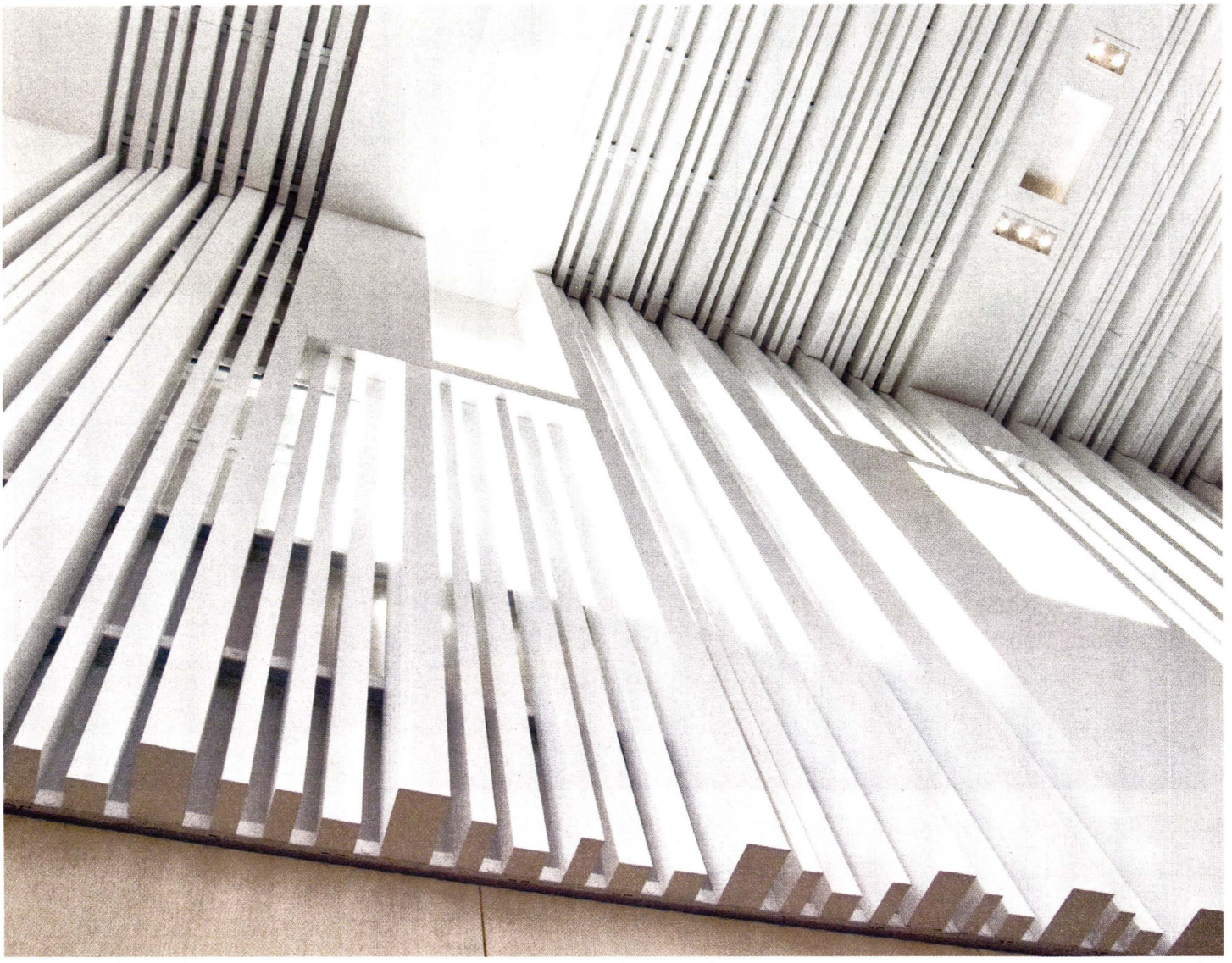
NBK TERRART Solid

Hunter Douglas Contract hunterdouglascontract.com

An alternative to concrete panels, this precast terra-cotta product is available as a facade with pre-grouted joints or rainscreen with shiplap joints. The ceramic elements are specifiable in widths of up to 2', lengths up to 4', and thicknesses up to 1¼". Surface finishes include natural, peeled, polished, and glazed, while several color options range from traditional earth hues to charcoal and stone. CIRCLE 203

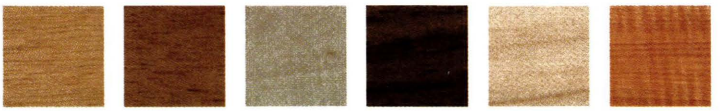
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PHOTOGRAPHY: © JAMES EWING

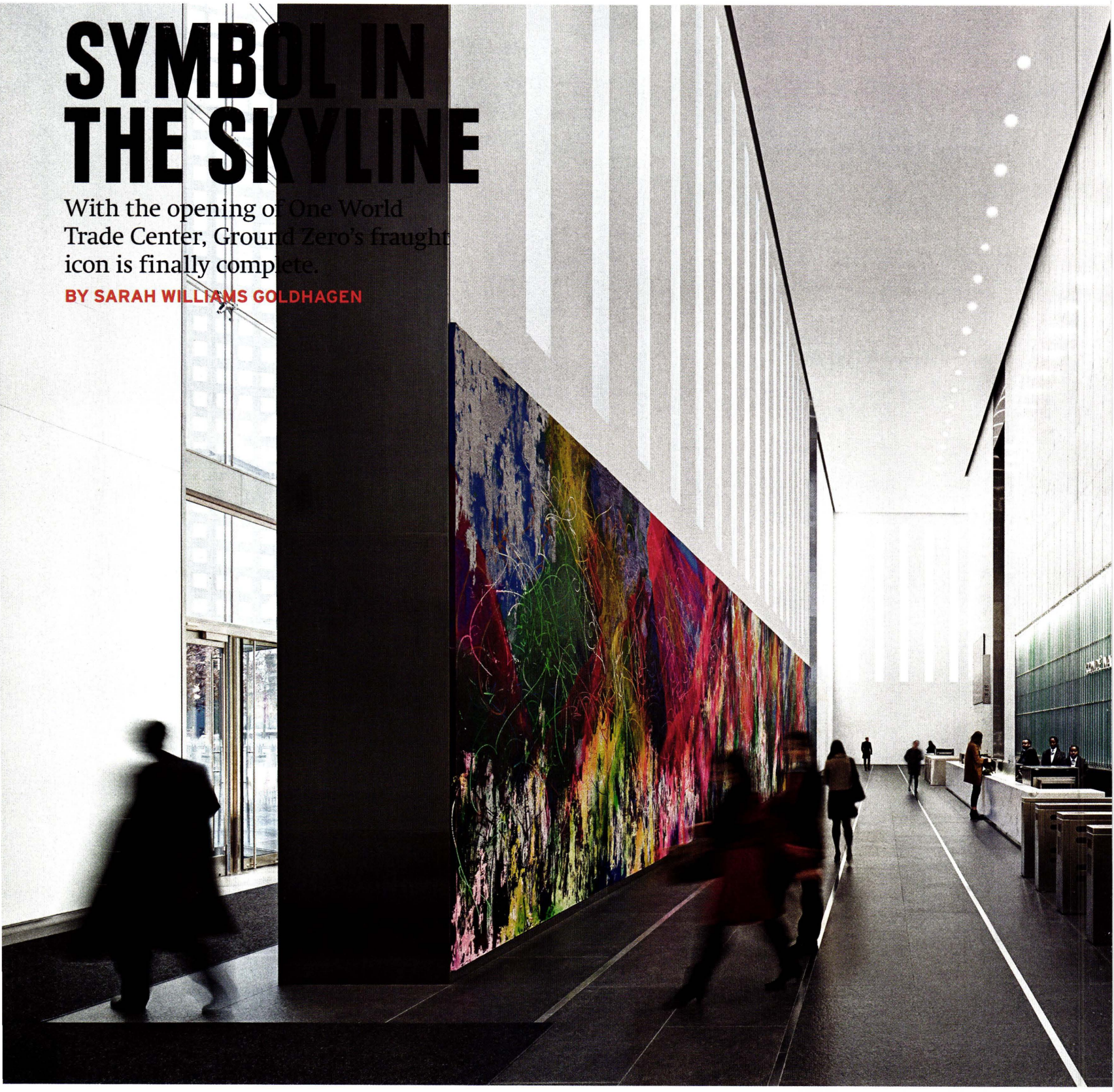
GROUND ZERO'S NEXT CHAPTER

Not long after the 9/11 terrorist attacks, the late critic Ada Louise Huxtable addressed the questions swirling around the rebuilding of Ground Zero by writing, "If the usual scenario is followed, the debate will lead to a 'solution' in which principle is lost and an epic opportunity squandered." Now that two of the largest projects in lower Manhattan are complete, what is the verdict? The Fulton Center, conceived in the wake of the tragedy, brings logic to a tangle of transit lines that converge nearby, under a dramatic daylit urban space. And all eyes have been on the design of One World Trade Center, which had the opportunity to fulfill a public desire for a meaningful landmark on that sensitive ground. In the following pages, we assess both of these enormously complex buildings.

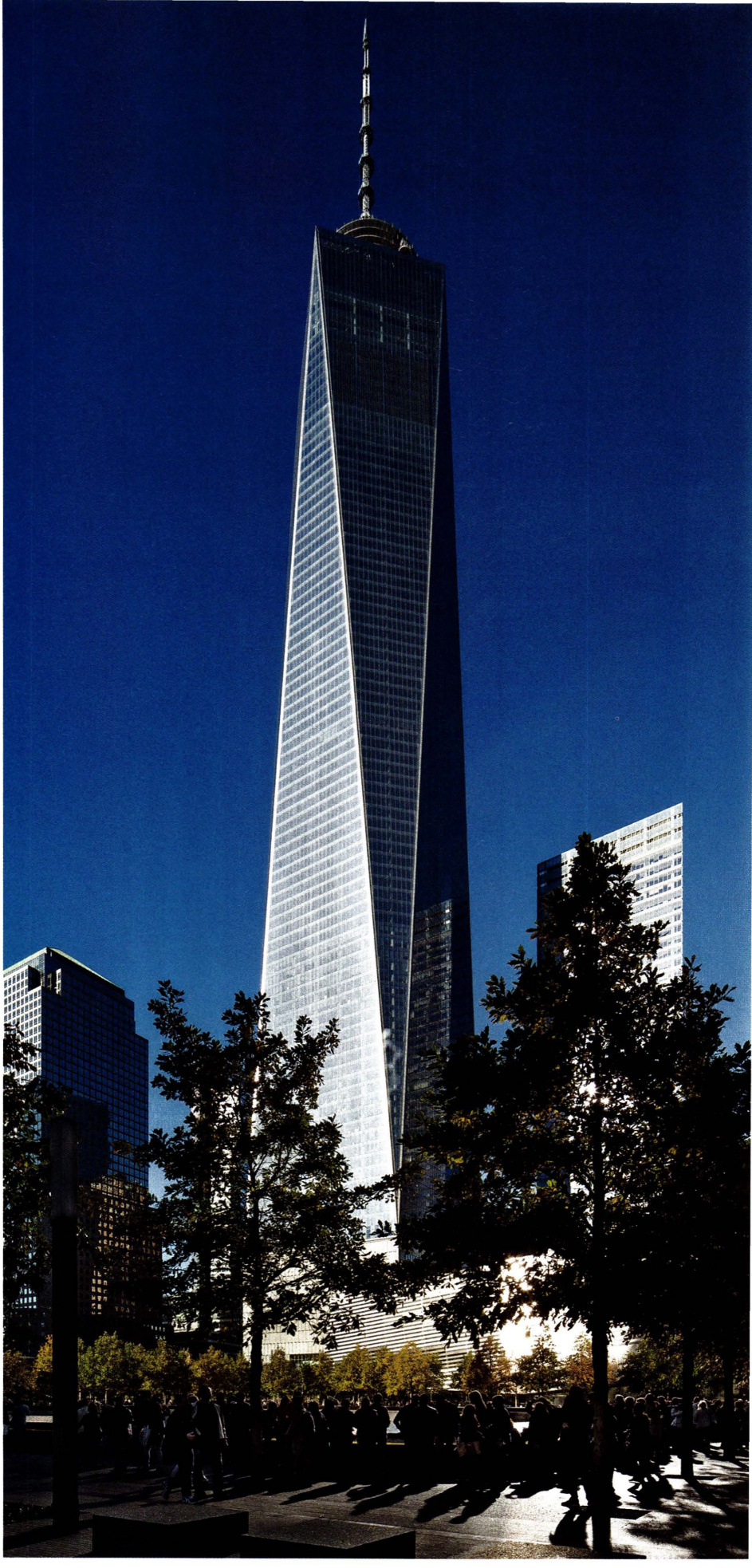
SYMBOL IN THE SKYLINE

With the opening of One World Trade Center, Ground Zero's fraught icon is finally complete.

BY SARAH WILLIAMS GOLDHAGEN

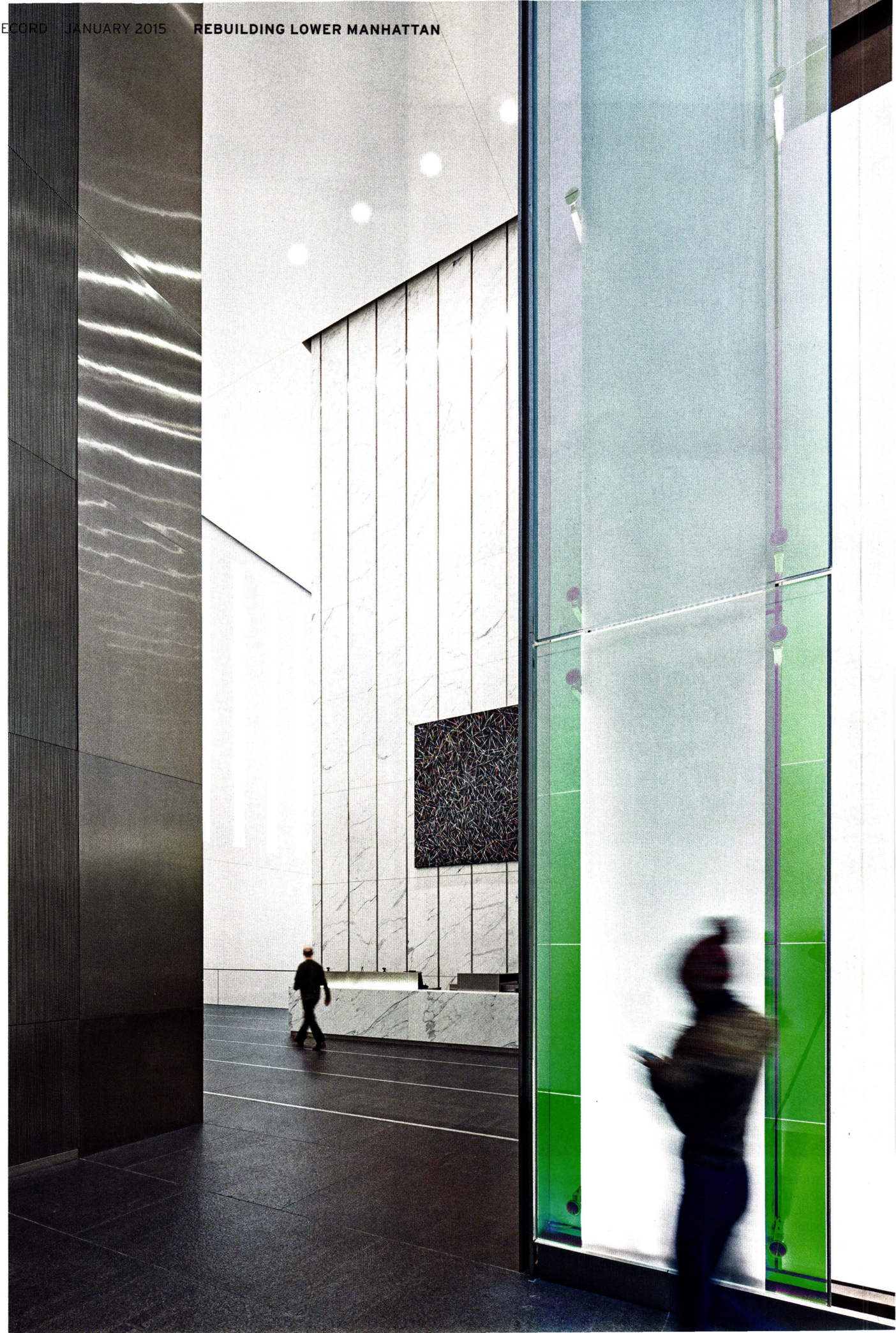






PHOTOGRAPHY: © JAMES EWING, EXCEPT AS NOTED

SUPERTALL Although One WTC's lobby (above) is 50 feet tall, the Carrera-clad space feels constrained—a consequence of thick perimeter walls and a hefty core. From the outside (right), the large, ultraflat curtain wall panels and chamfered corners make the tower appear almost like a carved obelisk.



MUTED PALETTE
The primary tenant entrances include a wall of dichroic glass panels (right). These draw on the spectral qualities of light to provide patterns of vibrant color in the otherwise mostly black-and-white lobby. The building's 71 high-speed elevators (opposite) travel at 2,000 feet per minute.

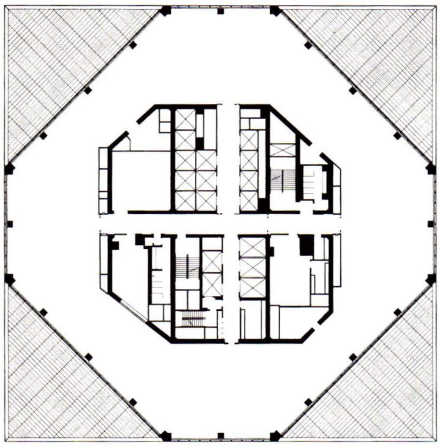
Thirteen years, an ocean of cash, and such a torrent of words that by the end nearly everyone had averted their eyes: finally, One World Trade Center, by Skidmore, Owings & Merrill (SOM), officially the tallest building in the Western Hemisphere, on the 16 acres of Ground Zero, has opened.

Forget, for the moment, the site's history, and let's just describe what's there. Just north of the 9/11 Memorial fountains, One WTC rises 1,776 feet from the ground plane to the tip of its antenna. The boxy, largely windowless base is 200 feet square in plan and 186 feet tall. Punctured with four street-level entrances, its 28-inch-thick concrete walls are clad in a two-ply skirt: narrow, horizontal stainless-steel slats peek from behind a scrim of vertical translucent glass fins. Floor plates at the base and crown are square; between them rise 71 stories of rentable office space, as well as mechanical floors and soon-to-open observation areas and restaurants, all contained in an elegantly glazed, curtain-walled prism. Between the square base and crown, the tower's corners are chamfered, so that by its midpoint, the floor plate has become a regular octagon. This creates an obelisk-like effect when you look up at the building, with the tower's thinly attenuated isosceles triangles appearing to lean into the skyline of lower Manhattan.

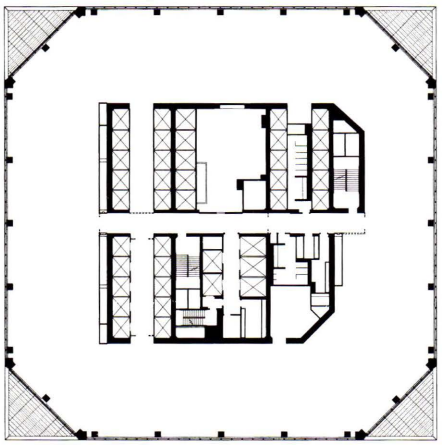


Beyond that, what we see in this building will capture our own reflected image, revealing both something of what is physically there and something of who we are. Tourists and city dwellers will first assess the overall design (do I like the way it looks?) and urbanism (does it work in the neighborhood?). Users will value the location, access to public transportation, and the quality and flexibility of its spaces. Design and engineering professionals will note advances in technology and materials. Developers will see the bottom line.

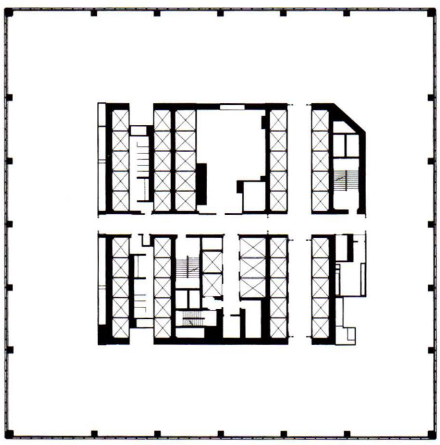
What anyone sees in the building, however, must inevitably reflect the story of the site's and the project's history. The horrific events spawning this building's inception, the massive outlay of public money devoted to its execution, the efforts of thousands of people, including community leaders, design professionals, city planners, state bureaucrats, and ordinary citizens who offered and grappled with ideas for the World Trade Center's rebuilding after 9/11 . . . it all makes One WTC a singular project, larger than its clients,



TYPICAL HIGH-RISE FLOOR PLAN



TYPICAL MID-RISE FLOOR PLAN



TYPICAL LOW-RISE FLOOR PLAN

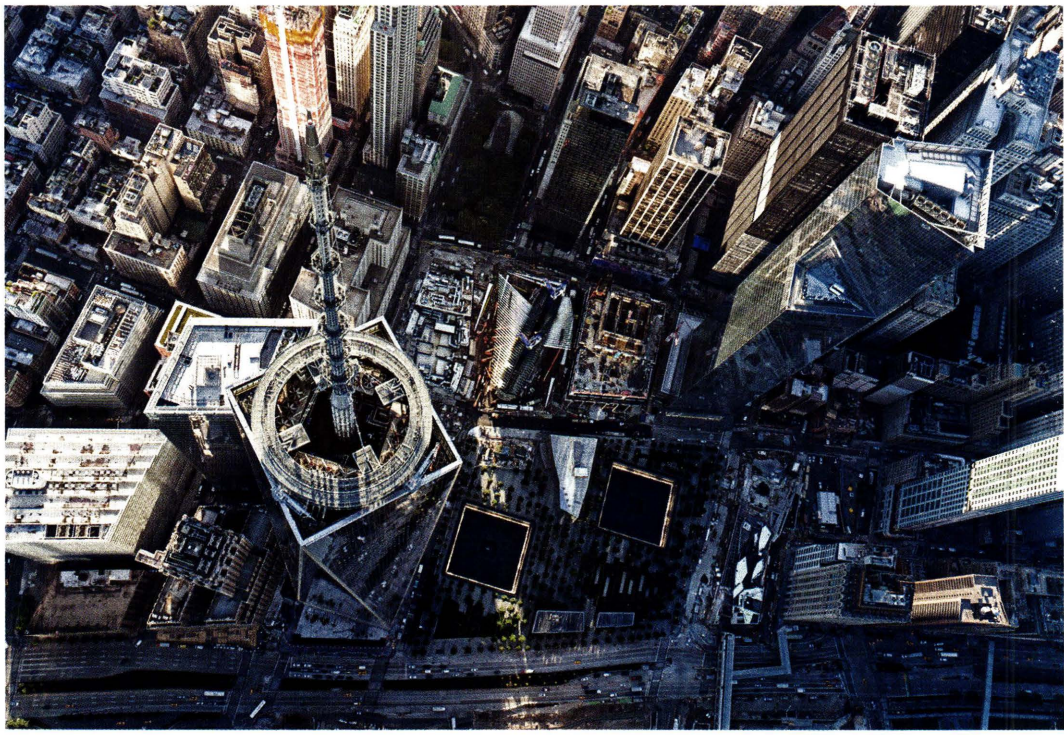
0 30 FT. 9 M.

financiers, architects, and tenants; larger even than survivors' families and New York City's residents. One WTC is a project fraught with the agony of meaning. Everyone had every right to expect a major civic icon.

Which we did not get. This is a fair-to-middling commercial office building with some notable good features. Viewed from afar, One WTC's sheer, mullionless glass planes cut a strong figure into the skyline, restoring the balance between Manhattan's Midtown and downtown and visually anchoring the new World Trade Center complex. Urbanistically, the restoration of Fulton and Greenwich streets (obliterated by the original World Trade Center complex) will help draw pedestrian life to the 9/11 Memorial plaza, especially as the streets are closed to ordinary vehicular traffic. Professionals will be impressed by the technological advances, such as the large panels of thick low-iron glass that facilitated the facade's appearance of flat sheerness, or sheer flatness, without the "oil-can effect" that makes so many glazed tall buildings look chintzy. People who work in the building will rejoice in the abundant natural light admitted through its floor-to-ceiling windows—on most days, little artificial illumination is needed—and its open, columnless spaces, made possible by the reinforced concrete core surrounded by a steel frame (see sidebar, page 75). And from inside its upper stories, the views are just spectacular.

All this is not to be dismissed. It is testimony to the successful collaboration, even in these complex, high-stakes circumstances, among the lead designer, David Childs, and his team at SOM, and the client, the Port Authority of New York and New Jersey. We can take heart that to accomplish this project, many people committed to collaborating, and collaborated well.

But that cannot be the end of this story. One WTC is not just a private commercial office tower. It is a publicly as well as privately financed project with a cost of $3.9 billion that was appropriately promised and promoted to the families of 9/11's victims, traumatized New Yorkers, Americans, and citizens of the world as a symbol of the city's resilience and the country's strength. Nothing less than a magisterial civic icon was in order—and we could have had one. For several years, the media and the public swarmed over inspired, or at least good, proposals for what the site could become. The Lower Manhattan Development Corporation (LMDC), a governmental body, reportedly favored one superb project, by the collaborative THINK, which would have turned the site into a public amenity. Another



SENSITIVE SITE One WTC anchors the northwest corner of Ground Zero, just at the edge of the memorial plaza containing the pools marking the footprints of the Twin Towers.

PHOTOGRAPHY: © IWAN BAAN

CLOSE-UP

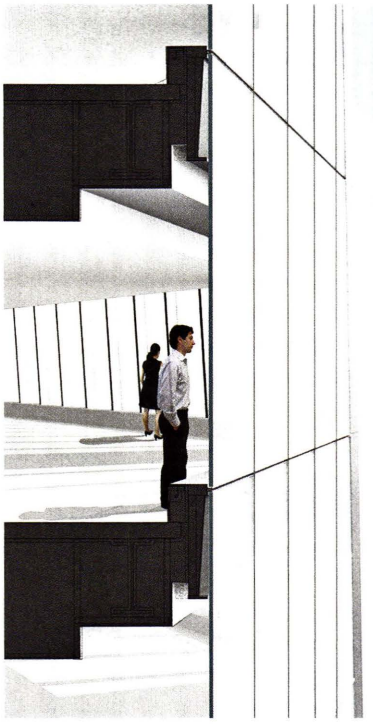
SECURITY MEASURES

Some of the security features at the World Trade Center and the recently opened office tower One WTC are hard to miss. For example, it is difficult to overlook the formidable barricades and guard booths preventing cars from entering the 16-acre Ground Zero site. And at the skyscraper's entrances, only the most inattentive visitors will not perceive the building's beefy, 28-inch-thick podium walls, even though the high-strength concrete base has been camouflaged on the exterior behind metal louvers and glass fins and the lobby interior has been sheathed in Carrera marble.

While these measures are obvious, most of the building's other security and life-safety features are as inconspicuous as they are robust, such as the building's reinforced-concrete shear-wall core surrounded by a steel moment frame designed to prevent progressive collapse. The elements enclosed within the core include exit stairs that are more than 60 percent wider than required by code and are pressurized to keep smoke out, a separate pressurized stairwell for first responders, and a "fireman's lift"—an elevator that functions as a service elevator during day-to-day operations but is equipped with water-resistant controls and a second door that opens onto a pressurized, dedicated fireman's lobby.

Even the high-performance curtain wall, which is responsible for the office spaces' generous daylighting, contributes to the tower's security. The extra-large insulated glazing units (IGUs)—5 feet wide and 13 feet 4 inches tall—which span the full floor-to-floor height without intermediary mullions or spandrels, have extra-thick outer lites. These are a minimum of ⅜ inches (standard thickness is ¼ inch) to help keep the glass surface smooth and flat. The inner lites, meanwhile, are laminated, and their thickness varies depending on location: the glass in some areas is thicker than others due to security concerns.

Joann Gonchar, AIA



UNOBSTRUCTED
The large glazing units span from floor to floor without mullions or spandrels, providing unimpeded views, especially from the upper floors. The configuration also maximizes daylighting.

proposal, less good but at least acceptable, by Daniel Libeskind, was officially selected, under pressure from then New York State Governor George Pataki. And a third, excellent design by the world's best commercial skyscraper architect, Norman Foster, stood ready to hand.

So if we assess One WTC from the perspective of what feasibly *could* have been and what feasibly *should* have been there? Get out your handkerchiefs.

As a civic icon and a public monument, what One WTC mostly represents is a gross betrayal of public trust. In no way is it remarkable. No one's heart will soar at its prospect. The base is horrendously clunky, the overall composition disjointed and incoherent. It crashes into rather than meets the ground. The proportions of its white-Carrera stripped neoclassical lobby are oppressively tight, so that upon entering we confront all planes and no grace—a sequence of thick walls, from the podium's imposing perimeter to the hefty cores—all concessions to security concerns.

The mantle of responsibility for One WTC's failure falls on individual actors and their decisions, some of whom are

credits

ARCHITECT: Skidmore, Owings & Merrill – David M. Childs, design partner; T.J. Gottesdiener, managing partner; Kenneth A. Lewis, managing director; Nicholas Holt, technical director; Nicole Dosso, senior technical designer; Julie Hiromoto, project manager; Frank Mahan, senior design architect

ENGINEERS: Jaros Baum & Bolles (m/e/p, sustainability); Steven Kinnaman & Associates (vertical transportation); Weidlinger Associates (protective design engineer); WSP Cantor Seinuk Group (structure); Schlaich Bergermann und Partner (spire/cable net wall structure); Philip Habib and Associates (civil and transportation); Mueser Rutledge Consulting Engineers (geotechnical); Vidaris (facades); LERA Peer Review and Historic Structures (peer review)

CONSULTANTS: Mathews Nielsen Landscape Architect and Peter Walker Landscape Architecture (landscape); Claude R. Engle and Brandston Partnership (lighting); Cerami (acoustical)

CONSTRUCTION MANAGER: Tishman Construction Corporation/AECOM

PROGRAM MANAGER: STV

CLIENT: 1 World Trade Center LLC, a wholly owned corporation held by the Port Authority of New York and New Jersey and the Durst Organization

SIZE: 3.5 million square feet

COMPLETION DATE: November 2014

SOURCES

CURTAIN WALL: Benson Industries

INSULATED GLASS UNITS: Viracon

STAINLESS-STEEL CORNERS: Pohl

PODIUM CLADDING ASSEMBLY: Permasteelisa North America

PODIUM GLASS FINS: Interpane, Bischoff Glasstechnik

PODIUM LOUVERS: Construction Specialties

LOBBY GLASS WALLS: APG International

STONE: Port Morris Tile & Marble, Cold Spring Granite, Savema, Mount Airy Granite

LOBBY COVE LIGHTING: Lumenpulse

PODIUM LED LIGHTING: Philips Color Kinetics

SPIRE LIGHTING: Barbizon Lighting Company

VERTICAL TRANSPORTATION: ThyssenKrupp

FIRESTOPPING: Hilti

FIREPROOFING: Grace

MILLWORK: Bauerschmidt & Sons



BEFORE AND AFTER As realized, One WTC's base is clad in horizontal stainless-steel slats and vertical glass fins and has squared-off corners (above and far right). It is crowned with a 441-foot-tall antenna. Earlier plans (right) called for a prismatic-glass-clad base with chamfered corners and a radome enclosure for the spire.

known, and others not. Inexcusable Decision No. 1 was Pataki's unilateral choice of Libeskind, who was then inexperienced in designing commercial towers. This inexperience and the nature of the One WTC public-private partnership with the developer Larry Silverstein (who later left the project) created an opportunity for Silverstein to bring in his architect of choice, SOM's David Childs.

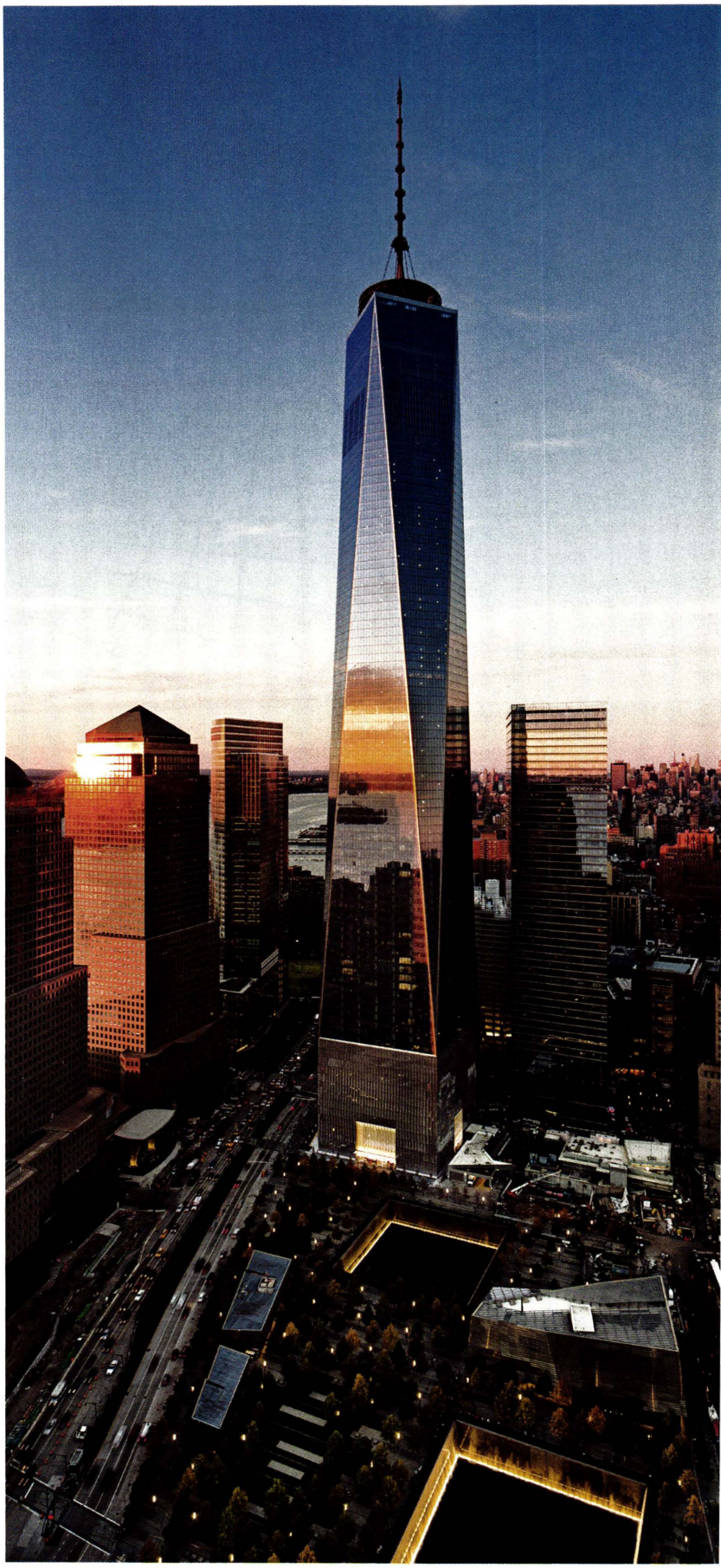
Other actors may be nameless but not blameless: Inexcusable Decision No. 2 was the insistence of New York City's police department that this supertall tower be built to security specifications resembling those of a U.S. embassy on foreign soil. Building a 104-story skyscraper this way is ridiculous. It projects cowardice, not strength; as one architect involved in its design told me, we might as well live underground.

Inexcusable Decision No. 3 was the belief of the Durst Organization—the developer who acquired a stake in One WTC in 2010—in its incontrovertible right to meddle with SOM's design. Public-private partnerships are all structured differently. This one was structured so that the private partner, along with the Port Authority, could compromise the design—without formal public review—by making decisions that would be likely to maximize its profit. These included scuttling the prismatic glass intended to clad the podium rather than giving Childs and his team the leeway to identify the right manufacturer. It included an 11th-hour modification, also to the podium; it originally had chamfered corners that would have both mitigated—if not entirely resolved—the base's cloddishness and resonated with the design of the shaft. And it included Durst's cancellation of the faceted and tapering radome spire.

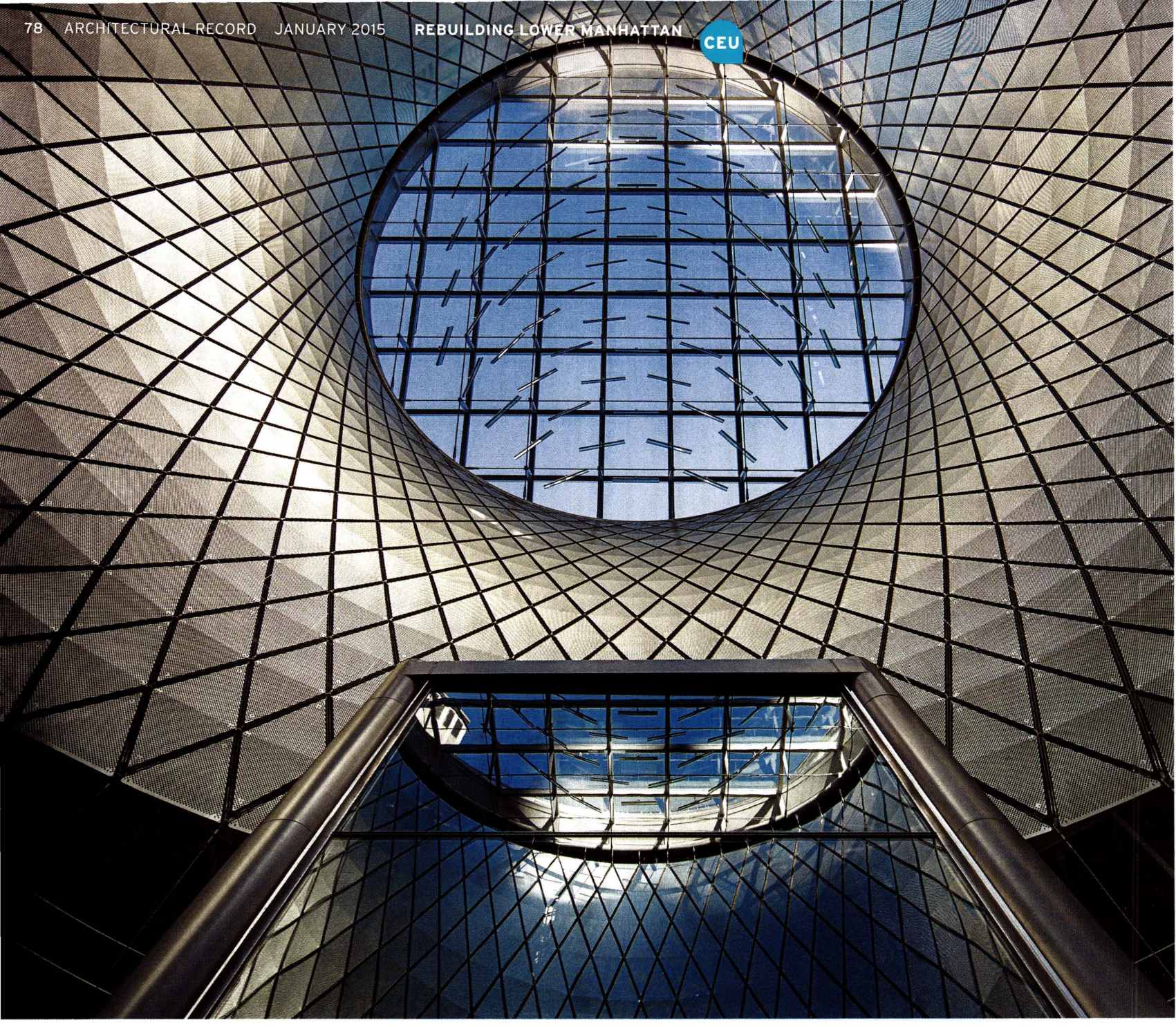
Public-private partnerships must be structured so that the public's interest is tenaciously safeguarded. At One WTC, it was not. Politicians, real-estate developers, police commissioners—many people are ignorant of the public value of great design. These people should not be making key design decisions without an independent design review. That many lost patience with One WTC—in the end, people just wanted it done—is no excuse. This building should never have become what it is: a failed project by an excellent design firm, and a symbol of American political incompetence, private ignorance, and greed. Surely New York City and the public deserve better than this. ■

Sarah Williams Goldhagen is writing a book on the experience of the contemporary built environment. She is the author of Louis Kahn's Situated Modernism *and* Anxious Modernisms.





PHOTOGRAPHY: © JAMES EWING



DOWNTOWN LOOKS UP

A multifaceted design team creates a 21st-century transportation hub for New York while preserving an important piece of the city's history.

BY JOANN GONCHAR, AIA

PHOTOGRAPHY: © JAMES EWING, EXCEPT AS NOTED



SUN CATCHER
Fulton Center's key orientation element is the sky-reflector net, the product of a collaboration among James Carpenter, Grimshaw, and Arup. It consists of a skylight and 952 diamond-shaped perforated aluminum panels held in place by a doubly curved cable net. The device drives daylight into the station's lower levels and is activated by the sky's changing colors.

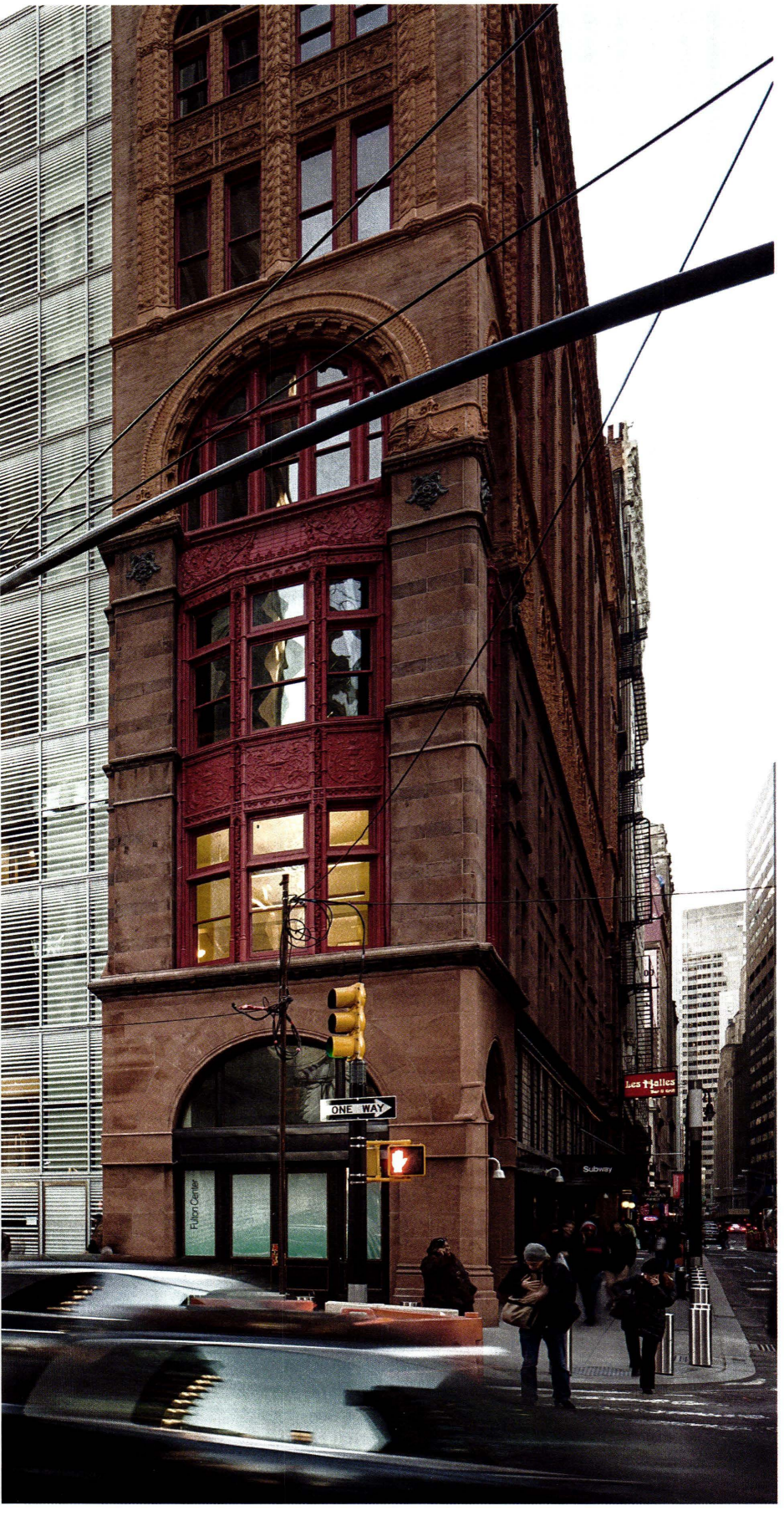
At the most basic programmatic level, Fulton Center—New York's new $1.4 billion transit hub—is a way for commuters to descend 40 feet from the street to the platforms for subway lines that overlap each other in a mazelike tangle in Lower Manhattan. One of the primary aims of the station, which opened in November and was conceived in the wake of the September 11 attacks, was to simplify access to these platforms. It was also intended to ease the cumbersome transfers among the lines, which were originally built by separate and competing commercial entities, some more than a century ago.

However, its design team set its sights on grander ambitions. "The aspiration was to create a space with the civic quality of Grand Central—one animated with daylight," says Vincent Chang, a partner at Grimshaw, the architecture firm responsible for Fulton Center's primary above-ground component—a dramatically skylit glass-and-steel pavilion, approximately 140 feet square and 100 feet tall.

Execution of Fulton Center's goals—both lofty and pragmatic—was anything but straightforward since the hub comprises several distinct elements: the pavilion; restoration of the Corbin Building, a 125-year-old landmarked structure that is now part of the station complex; reconstruction of about two dozen access points to the station's below-ground areas from the surrounding streets; and creation of a 350-foot-long underground passage that will connect subway riders to the World Trade Center once the Santiago Calatrava–designed

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ONE WAY
Fulton Center
Fulton Center
Subway



station opens later this year for the PATH—a passenger rail system that links Manhattan and New Jersey. The Fulton project was built under nine separate construction contracts and had three architects of record. In addition to Grimshaw, Page Ayers Cowley Architects was charged with the renovation of Corbin, while HDR|Daniel Frankfurt oversaw the design of the street-level access points. The team was led by Arup, which served as the project's prime consultant.

With so much complexity and a large volume of traffic (about 300,000 commuters are expected to travel in and out of Fulton Center daily), the design team needed to thoroughly analyze how people would move through the station. "With any transit project, there is a lot of competition for a limited amount of space," says Eric Rivers, a pedestrian planner with Arup. He points to the subway platforms as one problematic area: people use them as corridors as well as for boarding, alighting, and waiting for trains—all at the same time. "The only way to understand it was with a micro-simulation model," he says.

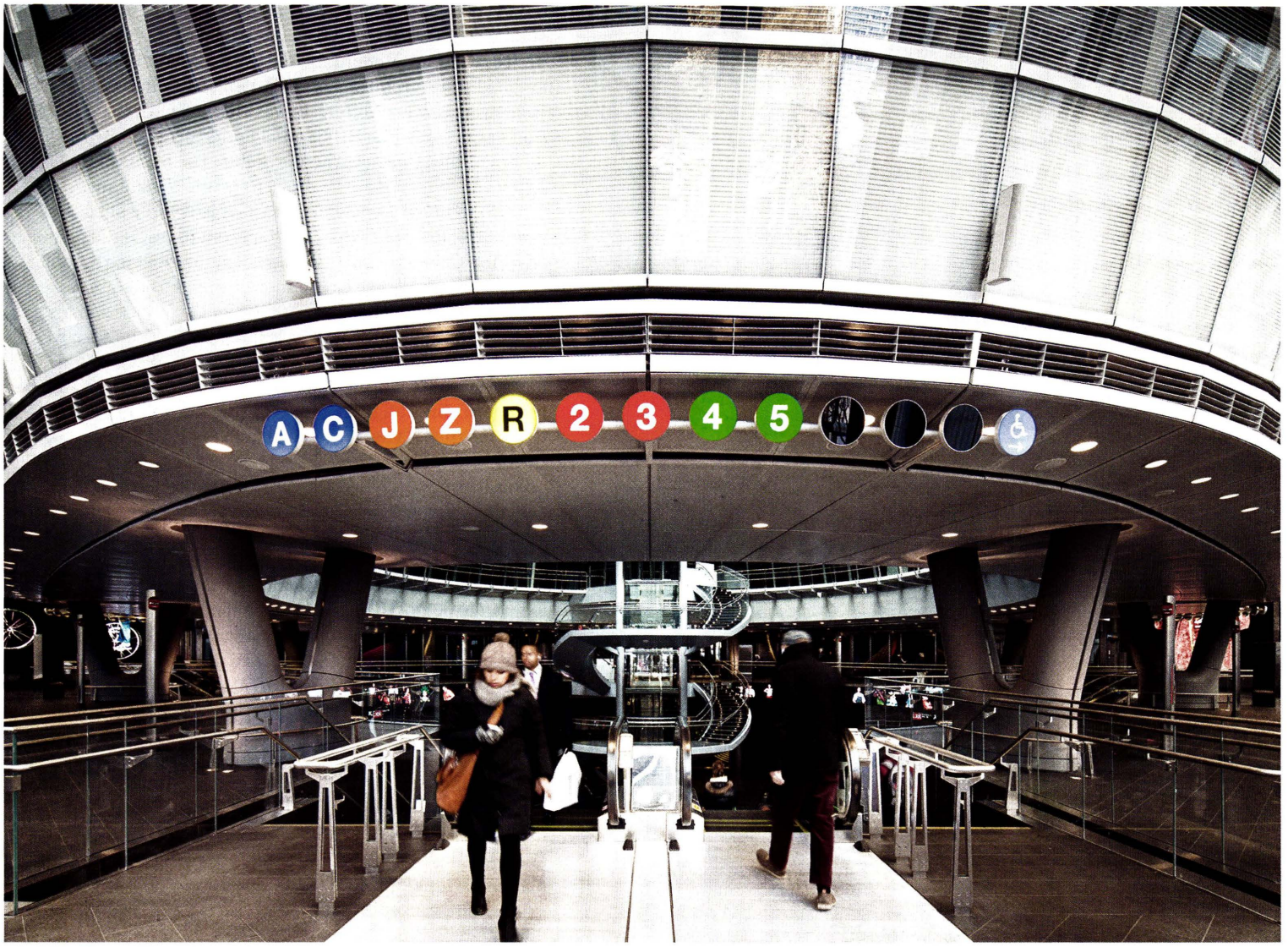
But because there were no crowd simulation tools available that modeled 3-D spaces effectively when the client, Metropolitan Transit Authority (MTA), selected Arup 11 years ago, the firm developed its own. The software, named MassMotion and now commercially available, allowed the team to populate the project's digital model with "agents," or virtual people, to evaluate how many passengers the facility could handle and predict what route they might take around structural elements or other obstructions, such as columns or walls. In the years since completion of Fulton's design phase, Arup has sufficiently developed the tool so that it can be used to understand how occupants will behave when faced with, for instance, a choice between a crowded escalator and a relatively empty set of steps. It can also help project teams to study the effect of operational changes, such as increasing the frequency of trains arriving at any given platform. "It helps inform design decisions," says Rivers.

The station's key orientation device is a $2.1 million oculus

PARTS OF THE WHOLE Fulton Center comprises multiple pieces, including a glass-and-steel pavilion (far left), the 125-year-old Corbin building (left), and a 350-foot-long tunnel (below) that will connect to the World Trade Center site once a Santiago Calatrava-designed commuter rail station opens there later this year.



PHOTOGRAPHY: © JOHN LEIMBACH (RIGHT)



created with James Carpenter—the frequent architectural collaborator who works with glass, among other materials, and the phenomenon of light. His scheme, which consisted of a multilayered glass skin for Grimshaw's then-dome-shaped skylight, was selected as the result of a 2003 design competition sponsored by MTA Arts and Design. Carpenter's competition entry was the "most carefully considered as part of the architectural concept," explains Andrew Whalley, Grimshaw deputy chairman. Carpenter says he was simply building upon the architects' fundamental goal for a dynamic, light-filled central atrium. "From the very beginning, our intent was to bring the sky into the space."

As realized, the oculus is a conical, metal-clad hat that protrudes from the roof of the pavilion and is angled toward the south to harness the maximum amount of sunlight. Within this shell, 952 diamond-shaped perforated aluminum panels are held in place by a net of 112 pairs of ¼-inch-diameter cables that form a skewed hyperbolic paraboloid, or hypar. This doubly curved net, about 50 feet in diameter and 70 feet tall, is tensioned between a compression ring at the top and the second-level floor plate at the bottom. The appearance of the device, called the "sky-reflector net," changes in response to the color and character of the sky.

The installation achieves this effect, in part, because the panels are made of a special optical grade of aluminum that reflects approximately 90 percent of the light that hits it, according to Carpenter. (Stainless steel would reflect about 60 percent, he says.) In addition, because the panels are only ⅛-inch thick, and have perforations that range from 20 percent open near the reflector net's top to 48 percent near the bottom, they seem almost gauzy.

These diaphanous qualities can be appreciated from multiple areas within the station, including one directly below the oculus, on an intermediary floor plate between the street level and the platforms that the architects refer to as the "lily pad" because of its circular shape. Another prime spot is inside the "doughnut"—two glass-enclosed levels that wrap the reflector net and are lifted off the ground plane on V-shaped columns. (The doughnut houses some of the complex's 66,000 square feet of commercial space that retail giant Westfield Group is leasing.) From this vantage point, which is likely to be a restaurant, visitors will have views

TRAVEL UPGRADE
One route to the subway platforms from the street takes commuters under the so-called "doughnut"—two levels of commercial space wrapped in glass and lifted off the ground plane on V-shaped columns.

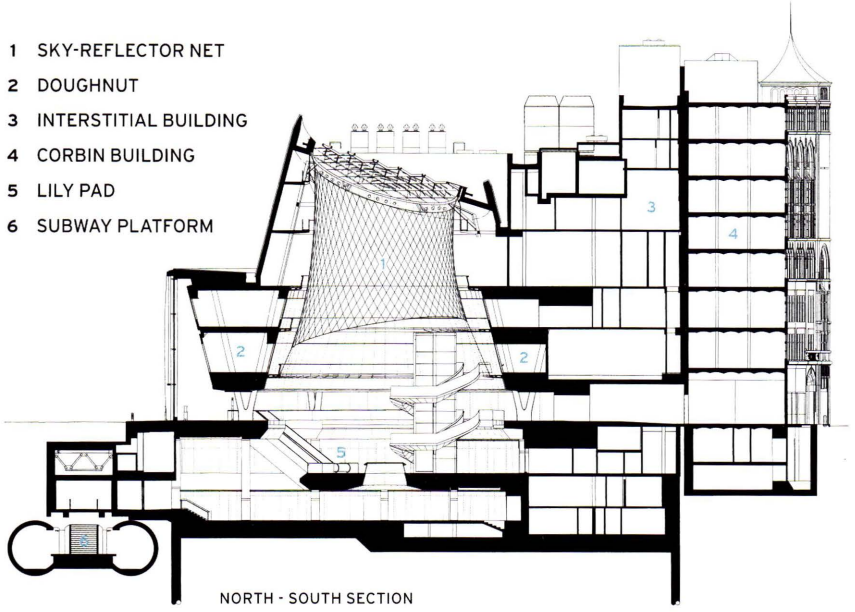


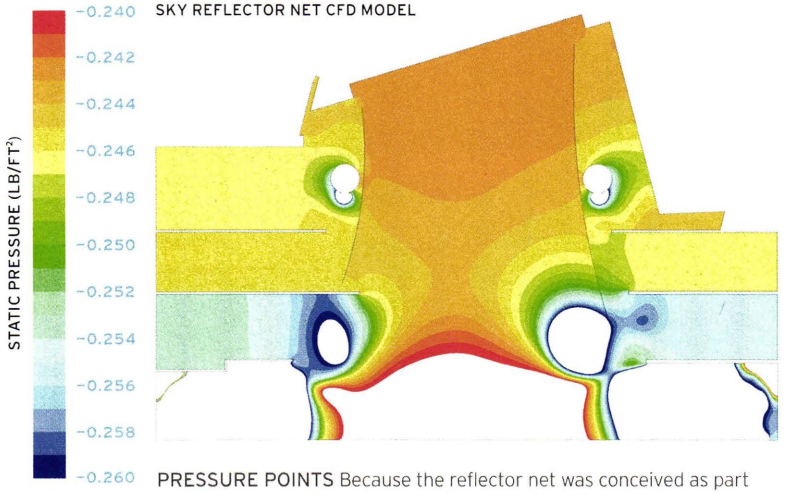
PROJECT: Broad Art Museum, Michigan State University. East Lansing, Michigan
DESIGN: Hamilton Anderson & Associates
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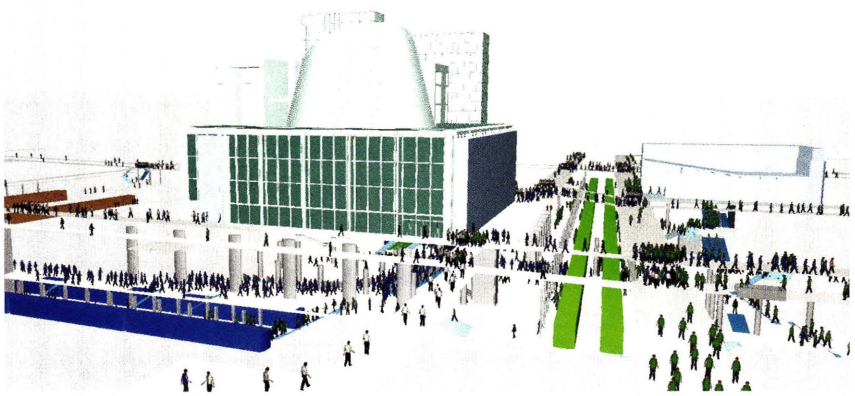
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CIRCLE 36





PRESSURE POINTS Because the reflector net was conceived as part of Fulton's ventilation system, engineers analyzed the effects of air movement on the device, relying on computational fluid dynamics.



PEOPLE MOVER To understand how commuters would circulate through Fulton Center, Arup examined the complex with a crowd simulation tool developed in-house. The software populates the digital model with "agents," or virtual people.

through the veil-like reflector net, of the skylight above and the station's activity below.

To understand the stresses that the delicate panels, the cables, and the node assemblies connecting them would be subject to, the engineers conducted numerous analyses. They even examined, with a computational fluid dynamic (CFD) model, among other types of studies, the effect of variable loads such as those created by thermal gradients and air movement. Since the reflector net was conceived as part of the pavilion's ventilation strategy, these factors could not be ignored: the apparatus behaves like a solar chimney, creating substantial convection and helping pull warm air out through exhaust ducts concealed behind the veil-like panels, explains Zak Kostura, an Arup associate.

The design of the pavilion and its reflector net were technically demanding, but the $84 million renovation of the Corbin Building, an eight-story masonry and iron structure built in 1889, offered its own set of challenges. Even though it was originally slated for demolition to make way for the new station, its designation as a national landmark in 2003 helped make federal funding available for its comprehensive renovation and integration into the station. It now defines the southern edge of the Fulton Center complex, provides both retail and office space for commercial tenants, and offers subway riders another route to the platforms.

Designed by Francis Hatch Kimball, Corbin was deemed historically significant because it is a "proto skyscraper," says Page Ayers Cowley. Although extremely skinny in plan (it is just 20 feet wide at its narrowest end and about 150 feet deep), Corbin was, at 142-feet high, briefly the tallest building in Manhattan. In addition, it was one of the first buildings to feature the tile vaulting invented by Rafael Guastavino. The system, which consists of multiple layers of thin terra-cotta tiles, became known for its fire resistance and its ability to accommodate large floor loads. The method would later be used at the Boston Public Library and the Ellis Island Main Hall, among many other buildings.

Corbin was also notable for its "extraordinary ornament both inside and out," says Cowley. However, decades of neglect and unsympathetic modifications had taken their toll on the elaborate decorative components, making restoration a painstaking process. For instance, the facade's approximately 5,000 terra cotta pieces were individually mapped for cleaning, patching, or replacement. More than 500 were deemed beyond repair, requiring that they be replicated. But because clay shrinks when fired, molds could not be formed from the existing pieces. Instead, artisans had to sculpt new positives, roughly 10 percent larger than the originals, before forming the molds.

Inside Corbin, one of the many elements that features opulent decoration is the central staircase's copper-plated cast-iron balustrade. Although this stair was in relatively good condition, its handrail height did not meet current code for an egress stair. In order to avoid having to alter an important piece of historic fabric, the Fulton team provided a separate egress stair in an "interstitial building" that connects Corbin and the pavilion. The narrow and towerlike steel-framed structure, which encloses back-of-house functions and mechanical equipment, also enabled the removal of unsightly external fire escapes that had cluttered Corbin's

IMAGES: COURTESY ARUP



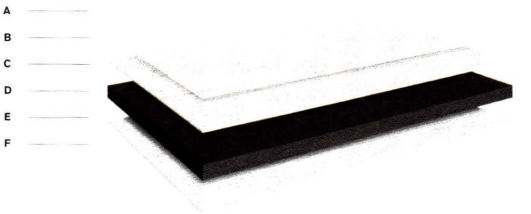
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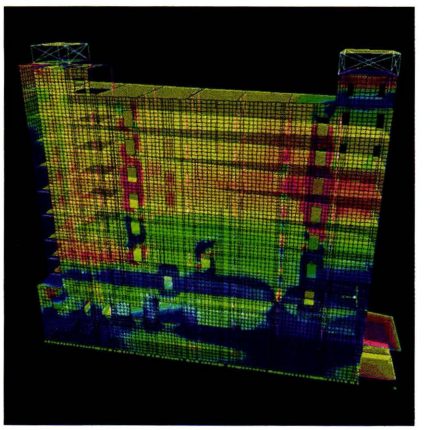
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CIRCLE 51



DRAMATIC DESCENT A new set of escalators leads commuters through Corbin's foundations.



STRESSED OUT Before retrofitting Corbin's lateral load-resisting system, engineers conducted various studies, including a structural analysis of the building's north wall.

facade since the 1970s.

The historic building's structure also required retrofit, especially to improve its lateral resistance to wind and seismic loads. This was accomplished by the reinforcement of Corbin's north exterior wall with shotcrete and rebar (now mostly hidden by the interstitial building) and the addition of an internal concrete lateral frame linked to the steel frame of the pavilion. In order to create a structural diaphragm at each floor level, the engineers replaced the original ash used as infill above the tile arches with lightweight cellular concrete.

Arguably, the most dramatic part of the renovated building is a new set of escalators that descend 20 feet below the original foundations and lead to the subway platforms. Contractors underpinned the foundations, an operation that required laborious excavation by hand because the lot was too tight for mechanical excavation equipment. During the process, Corbin was monitored with sensors and strain gauges to ensure it didn't develop unacceptable movements or stresses. The result is a three-story-deep wellway that reveals a series of inverted masonry arches. Passing under these arches, which were designed to distribute the superstructure's loads to the surrounding soil, "intensifies the feeling of going down into earth," points out Cowley.

These hefty footings, newly uncovered, offer the perfect counterpoint to the delicacy of the adjacent pavilion's reflector net. One element entices passengers to descend, through history, while the other draws their eyes upward, to a precisely machined device for capturing the sky. If only all New York City subway stations could have such synergies. ■

credits

PRIME DESIGN CONSULTANT: Arup

ARCHITECTS OF RECORD: Grimshaw (pavilion); Page Ayers Cowley Architects (Corbin restoration); HDR|Daniel Frankfurt (street-level access, Dey Street concourse)

CONSULTANTS: James Carpenter Design Associates (sky-reflector net)

CONSULTANT CONSTRUCTION MANAGER: PB-Bovis Lend Lease

CLIENT: Metropolitan Transit Authority

SIZE: 190,000 square feet

PROJECT COST: $1.4 billion

COMPLETION DATE: November 2014

SOURCES

OCULUS CLADDING: Radius Track

SKYLIGHT GLAZING AND ASSEMBLY: Viracon and United Skys

CABLE NET: TriPyramid Structures

REFLECTIVE PARASOLS: Saint Gobain

ENTRANCE DOORS: C.R. Laurence

GFRC CEILINGS AND COLUMN COVERS: Plaster Form

METAL CEILINGS, SOFFITS, AND CLADDING: Gordon Interior Specialties Division

GRANITE FLOOR TILE: Miller Druck International Stone

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Learning Objectives

1 Describe the various analytical studies conducted by the Fulton Center design team, including those for crowd simulation and computational fluid dynamics.

2 Explain the relationship between the sky-reflector net and Fulton Center's ventilation strategy.

3 Explain why the Corbin Building was innovative for its time.

4 Describe the techniques used to structurally reinforce the Corbin Building and preserve its elaborate decoration.

AIA/CES Course #1501A

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IMAGES: © IAN BUCKLEY (LEFT); COURTESY ARUP (RIGHT)





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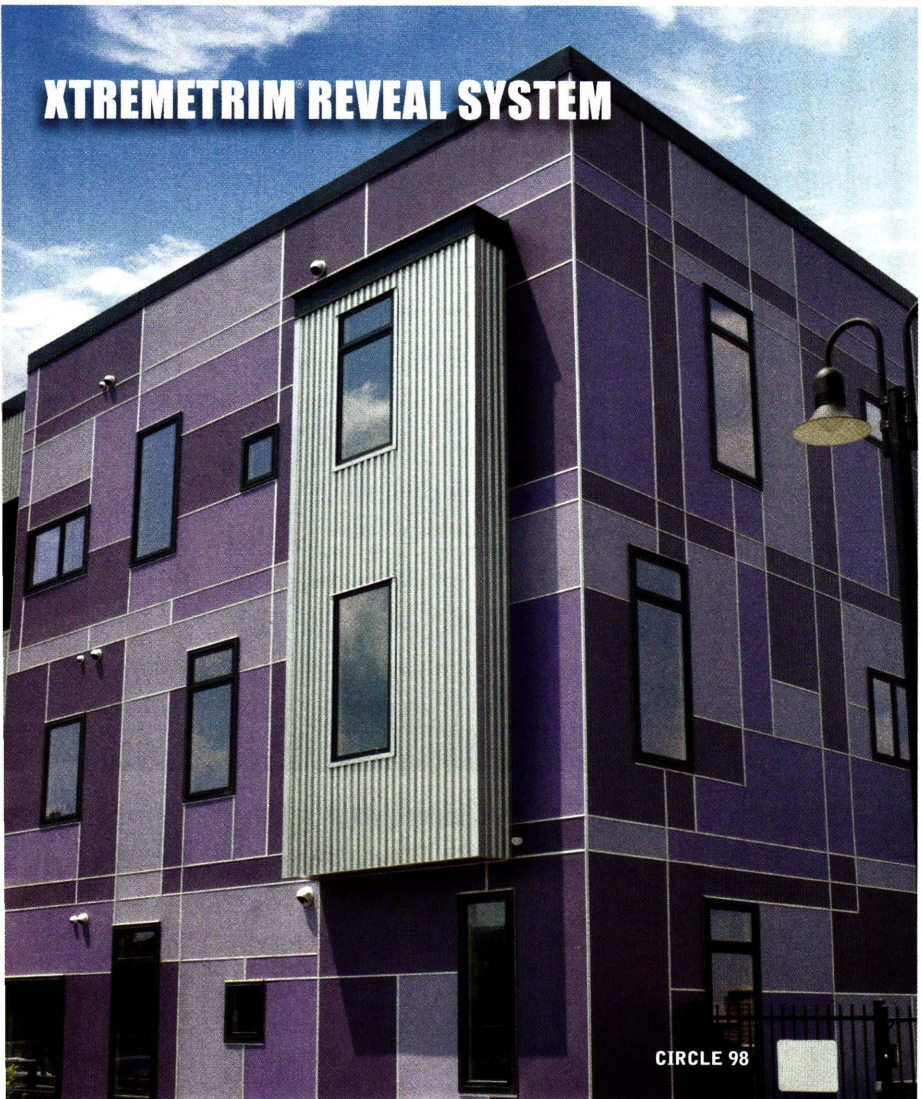
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PROJECT: Sanford Consortium

ARCHITECT: Fentress Architects

ASSOCIATE ARCHITECTS: Davis Davis Architects

LANDSCAPE ARCHITECT: Civitas, Inc.

GENERAL CONTRACTOR: Hensel Phelps Construction Co.

INSTALLER: Valley Crest Landscape Development



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CIRCLE 49

Schools of the 21st Century

A MICROCOSM of the world's most architecturally significant K-12 schools, RECORD'S annual review looks at recent projects that exemplify good design as a crucial component in a school's programmatic development. From an inner-city grade school in New York (pictured) and a bucolic one on Washington's Bainbridge Island, to a progressive high school for 1,200 students in Beijing, each demonstrates the value that thoughtful and sustainable architecture can have for the well-being of a community and the education of its children.

92 WILKES ELEMENTARY SCHOOL
98 PUBLIC SCHOOL 330
104 DREW CHARTER SCHOOL
110 GARDEN SCHOOL
118 INTRINSIC CHARTER SCHOOL
124 ERGOLDING SECONDARY SCHOOL
130 SEQUOYAH SCHOOL EXPANSION

PUBLIC SCHOOL 330, NEW YORK CITY, BY MURPHY BURNHAM & BUTTRICK
PHOTOGRAPHY: © TY COLE

Wilkes Elementary School | Mahlum | Bainbridge Island, Washington

Go With the Flow

A forward-looking design expresses a commitment to collaboration and blurs the lines between work and play.

BY BETH BROOME







With a reputation for liberal politics, picturesque landscapes, and a relaxed dress code, 28-square-mile Bainbridge Island in Washington's Puget Sound is viewed by many as an idyllic spot to raise a family. Once dominated by logging and ship building and, later, agriculture, the island has evolved into an affluent bedroom community of Seattle, just a 35-minute ferry ride away. Given its tight control on development and its promotion of green space, it is no surprise that the island—which prides itself on its small-town charm and progressive values—has high expectations for its schools, which reflect and promote the way of life here.

The original Wilkes Elementary School, dating to the mid-50s, had grown in an ad hoc manner into a cluster of four brick buildings with temporary trailers connected by covered walkways. Instruction often happened in its double-loaded corridors, and its heating and plumbing systems were failing. The municipality turned to Seattle-based architects Mahlum, which in 2005 developed its school district master plan. The first goal, say the architects, was to use the full 10-acre site, which was bifurcated by a 20-foot elevation change. But, more importantly, the team focused on creating a building that would embody the school's philosophy, which embraces a broad spectrum of learning styles (accommodating everything from multi-class gatherings to independent study), while underscoring collaboration and the educational value of play. "Teachers used to be like individual contractors, with their room as their domain," notes principal Sheryl Belt. "But you are always stronger as a team. We wanted to be connected, we wanted a flow."



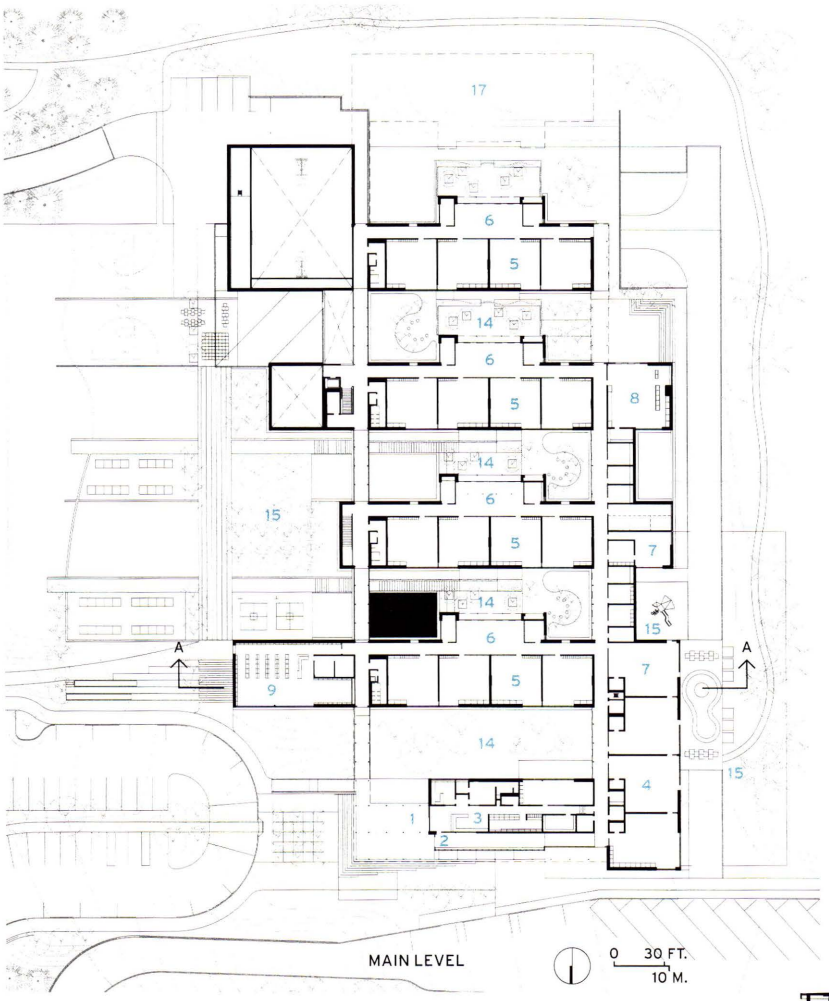
COMMUNITY CATALYST
A generous entry porch (left) encourages lingering and leads into a long, inviting vestibule. Bars of classrooms, with facades of concrete, dark brick, and stained cedar, reach out into the slope (above). The original school stood on the site's lower portion, where the parking lot now is (bottom).

Wilkes Elementary, which has 382 students, communicates its open vibe from the moment parents drop off their children at the covered porch that serves as the entry. The welcoming space prompts casual interactions among parents, students, and staff by inviting them to linger, and announces the value placed here on community and family participation in the education process.

To break down the building's scale, the architects organized the plan as a series of bars separated by courtyards. Within each wing, classrooms are linked by a

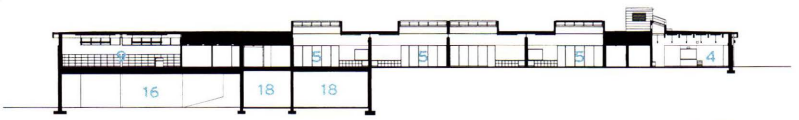
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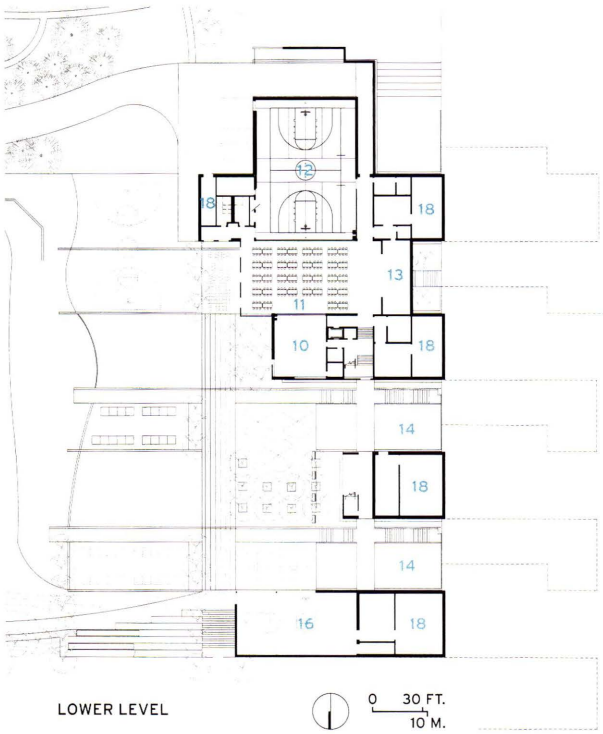
PHOTOGRAPHY: © BEN-JAMIN BENSCHNEIDER (LEFT); JEREMY BITTERMANN (2)



corridor that widens into a "shared learning space," where activity can spill out and special programs are hosted. On a recent morning, these areas buzzed quietly: children read independently while a volunteer set up an art project. "We wanted to encourage collaboration by getting not only kids, but also teachers, out of the classroom," says Mahlum managing partner Gerald (Butch) Reifert. "We thought of the classroom as a house, and the corridor and shared learning space as the porch." Two long hallways, running north to south, create a circulation ring that fosters interaction among the grades. "The building knits into the land," notes project designer JoAnn Wilcox, referring to the finger-like volumes that reach out into the site, which the team regraded into a gentle slope. "The overlay here is that teaching is about the whole child, and the idea of learning from play." To blur the lines between educational and recreational spaces while creating ample sight lines, the architects used extensive glazing, providing views between interiors and out to rain gardens, courtyards, and play areas while filling the school with daylight, even on a gloomy fall afternoon. Some people fear transparency, notes Reifert. "But we believe the opposite: the more transparent, the safer." The glass has other benefits, Belt adds. "Kids view the whole area as a classroom and know adults can see them every minute. They're more independent, because we can let them be."

The project added a cafeteria that doubles as a performance space and an enlarged gymnasium, which meets standards for competitive use. These facilities, along with the library, occupy the building's east side, and are accessed by a public hallway with its own entry. Outside school hours, they can remain open





1 COVERED PORCH
2 ENTRY
3 ADMINISTRATION
4 KINDERGARTEN
5 CLASSROOM
6 SHARED LEARNING AREA
7 PRE-K/RESOURCE/OTPT
8 ART
9 LIBRARY
10 MUSIC
11 CAFETERIA
12 GYMNASIUM
13 KITCHEN
14 COURTYARD
15 PLAY
16 COVERED PLAY
17 SERVICE ENTRY
18 MECHANICAL/STORAGE

credits

ARCHITECT: Mahlum – Gerald (Butch) Reifert, principal in charge; David Mount, managing principal; JoAnn Wilcox, project designer; Jesse Walton, project architect; Dwayne Epp, James Steel, Cristine Ross Traber, team; Amy Noe, Masako Wada, interior designers

CONSULTANTS: 2020 Engineering (civil); PCS Structural Solutions (structural); Arup (m/e/p); Cascade Design Collaborative (landscape)

GENERAL CONTRACTOR: Spee West Construction

OWNER: Bainbridge Island School District

SIZE: 64,450 square feet

CONSTRUCTION COST: $21.7 million

PROJECT COST: $29 million

COMPLETION DATE: September 2012

SOURCES

CURTAIN WALL: EFCO

MASONRY: Mutual Materials

WOOD: Issaquah Cedar & Lumber

CEILINGS: USG

RESILIENT FLOORING: Nora Systems



OVER AND ABOVE
Skybridges connect the classroom bars and are popular with students, who go out of their way to traverse them. "They're cool and give us more space for the playground," says third grader Cameron Albee. The architects thought of the grass areas below the bridges (right) as amphitheaters, but the children immediately turned them into hills to roll down. A covered play area, at right, occupies space under the library.



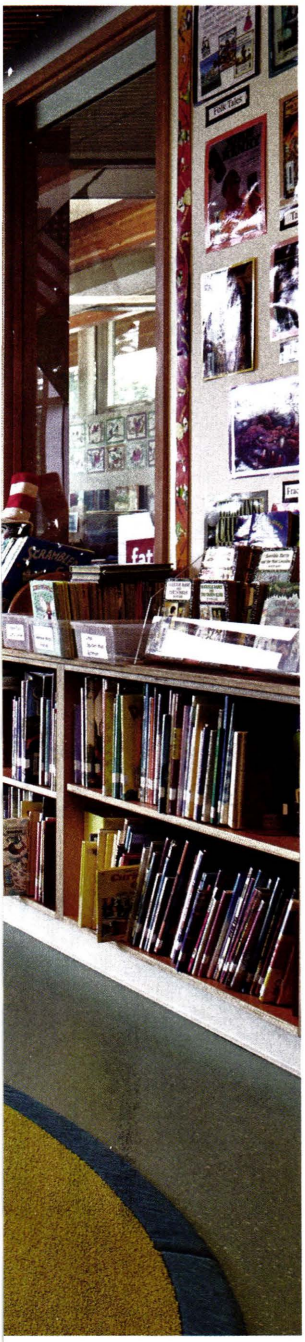
PHOTOGRAPHY: © BENJAMIN BENSCHNEIDER



and be used by the local basketball league or church groups. While creating a community amenity for the island's north end, which has no town center, these additions have surprising effects, too. For example, a separate cafeteria frees teachers from overseeing meals in their classrooms, points out Tamela J. Van Winkel, the district's director of facilities and capital projects. This buys 15 minutes a day, she says, "which adds up to eight days a year."

Dignified materials, like dark-fired brick, concrete, and wood are complemented with splashes of color on flooring and textiles—hues inspired by a student project on Matisse cutouts. These choices lend the school a serious yet joyful air without resorting to the condescending primary palette so often employed. And sustainable features abound, from nontoxic finishes to 100 percent on-site stormwater infiltration and waste-water treatment, heat recovery, and a hybrid radiant heating system with 45 geothermal wells.

Since it was founded in 1938, Mahlum has designed dozens of schools. "We look at each project as a template," says Reifert. "There are always lessons learned. We take many ideas and move them forward." But rather than applying a cookie-cutter approach whereby design elements are merely recycled, Wilcox notes, "We bring values. For example, we ask, 'How do we create connectivity?' Or quiet—how do we create the building as a backdrop for the life, the color, and the activity that students bring?" In the end, it's about place-making. "You layer on educational design principles, but the goal is to create a place that is whole—bigger than the sum of its parts." ■







BRIGHT SPOTS
Extensive glazing links interior spaces to each other and to the outdoors, as in the library (above), classrooms (top), and shared learning spaces (right). Thermal comfort is aided by radiant heat beneath the recycled-rubber flooring and sensors that instruct teachers when to open windows.

PHOTOGRAPHY: © BENJAMIN BENSCHNEIDER

Public School 330 | New York City | Murphy Burnham & Buttrick

In Full View

Infused with a welcome transparency, a public elementary school opens to a burgeoning community and its children.

BY LINDA C. LENTZ





PHOTOGRAPHY: © TY COLE



CLEAR VISION
P.S. 330 brightens Northern Boulevard in Corona, Queens, with a graphic powder-coated aluminum entrance (opposite). Largely clad in precast concrete panels to save time and avoid weather-related delays, the building features unimpeded high-impact glazing at grade, offering views through its ground floor and into a glass-lined basement "gymatorium" (above). Daylit public areas are detailed with wood-slat ceilings, built-in benches, and a 13-foot-wide corridor, 5 feet wider than the norm (right).



View additional images at architecturalrecord.com.

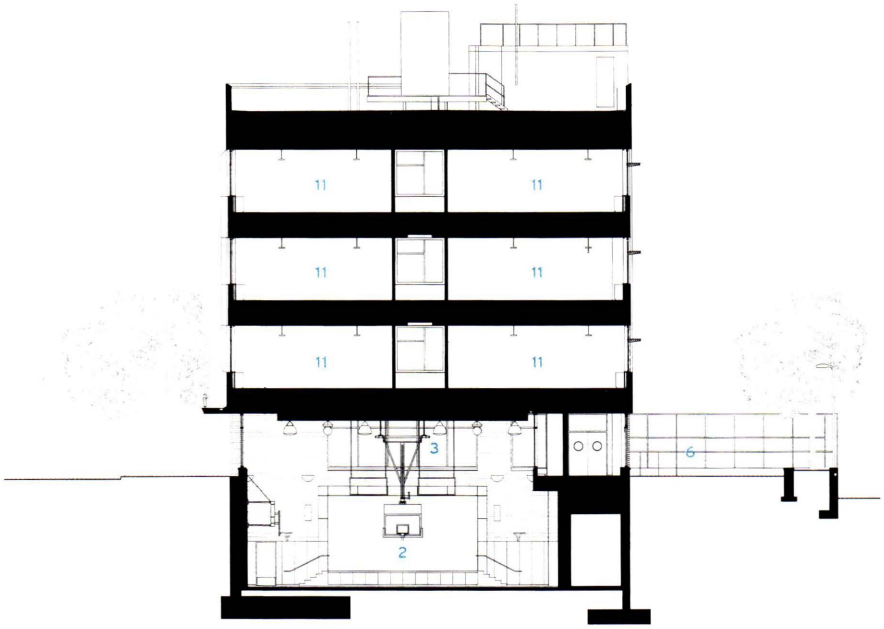
Just blocks from New York's Flushing Meadow Park—home to the 1939 and 1964 world's fairs as well as the Billie Jean King National Tennis Center and the Mets' Citi Field baseball stadium—Public School 330 is a local attraction in its own right. This cheerful elementary school in Corona, a neighborhood in the borough of Queens, not only provides much-needed classrooms here but also opens a window onto the education of the community's children.

Corona has long been a microcosm of the city's dense ethnic diversity. Dominated today by young working-class Latin American families, the area has grown from close to 99,000 people during the 2000 Census to over 109,000 in 2010, the year P.S. 330 was established. At the time, this populous district didn't have a permanent location for the nascent school, so its initial 200 kindergartners (and subsequent students), all overflow from overcrowded Corona schools, were bused more than 2 miles to a temporary incubator space in a former parochial school.

By the fall of 2013, the children were able to walk to a new school. Designed by the New York–based Murphy Burnham & Buttrick for 420 kindergarten through 5th-grade students, the 65,000-square-foot building spans a city block on a former parking lot between a commercial thoroughfare and a cluster of low-rise houses and apartment buildings. The site is 211 feet long and ranges in width from 136 feet on its west side to a scant 88 feet on the east. In order to accommodate the programmatic and logistical requirements specified by the New York City School Construction Authority (SCA), the architects negotiated the quirky site by stacking the four-story steel superstructure along its north edge. They situated the main entrance, offices, restrooms, mechanical closets, and ancillary teaching spaces on the busy (and noisy) street side. Then they placed classrooms, shielded by external sun louvers, on the quiet south side, where they were also able to fit a requisite double playground for older and younger kids. Mindful of the project's tight construction schedule, the design team requested a variance from the SCA's standard



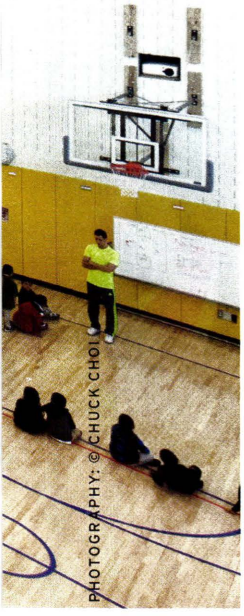
COURTSIDE SEATS
Sunlight streams onto the cafeteria's pumpkin-orange vinyl-tile floor as kids enjoy lunch. Adjacent to the schoolyard and glazed public corridor, the friendly eating area also overlooks the gym-cum-auditorium, or "gymatorium," a well-equipped space, lined with acoustic concrete masonry units, that has a stage and tiny dance studio at one end.



SECTION A - A

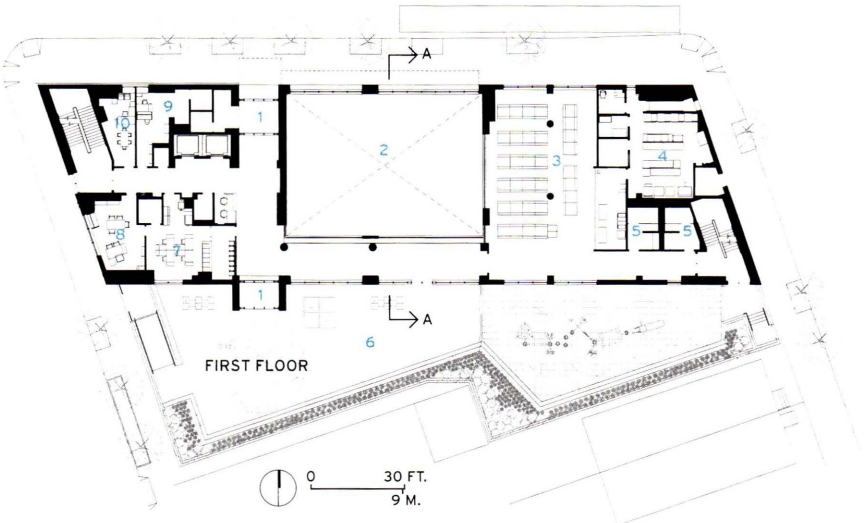
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PHOTOGRAPHY: © CHUCK CHOI





credits

ARCHITECT: Murphy Burnham & Buttrick – Jeffrey Murphy, partner in charge; Mary Burnham, partner; Jose Miranda, project manager

ENGINEERS: Robert Silman Associates (structural); Langan (civil/geotechnical); Loring (mechanical)

CONSULTANTS: Langan (landscape); Loring (lighting); Cerami (acoustical/audiovisual); Heintges (building envelope); U.S. Concrete (precast concrete)

GENERAL CONTRACTOR: T.A. Ahern

CLIENT: New York City School Construction Authority

SIZE: 65,000 square feet

CONSTRUCTION COST: $36 million

COMPLETION DATE: September 2013

SOURCES

CLADDING: Universal Concrete (precast concrete); Carolina Ceramics; Mutual Materials; Watsontown Brick (masonry)

WINDOWS: Trulite; Safti First (glazing); EFCO (metal frame)

INTERIOR FINISHES: USG (ceiling); Armstrong (ceiling and vinyl tile); Daltile, American Olean (ceramic tile); Silestone (quartz); Sherwin-Williams (paint); Nevamar, Wilsonart (plastic laminate)

1 ENTRY VESTIBULE
2 GYMATORIUM
3 CAFETERIA
4 KITCHEN
5 RESTROOM
6 PLAYGROUND
7 ADMINISTRATION SUITE
8 PRINCIPAL'S OFFICE
9 CUSTODIAN OFFICE
10 PARENT COMMUNITY ROOM
11 CLASSROOM
12 LIBRARY
13 OFFICE
14 MECHANICAL ROOM



brick cladding, swapping it for a simple facade made of precast concrete panels hung above a base of staggered red bricks, which was erected in two weeks without scaffolding.

The resulting trapezoidal building is light and airy, and establishes an immediate connection with the community via friendly patterns of fenestration that encourage views inside and out. Vertical slices of window wall reveal brightly colored stairwells as well as the school library, where artist Terence Gower's sculptural tribute to onetime Queens resident Isamu Noguchi floats from a double-height portion of the ceiling. (It was commissioned by the Public Art for Public School program.) At ground level, horizontal runs of high-impact exterior glazing and interior windows allow passersby to look directly through the building to the playground out back, into the cafeteria, and down to a glass-enclosed gym/auditorium in the basement. Dubbed the "gymatorium" by the architects, this space holds up to 314 occupants and has a stage-cum-dance studio at one end.

Newcomers feel welcome when they enter the bright green portal for the first time. The floor plan is logical and clear—with offices to the right, the schoolyard door straight ahead, and a path to the cafeteria (overlooking the gym) on the left. The firm's thoughtful use of materials, such as wood slats for the ceiling throughout these public areas, results in a warm environment with a unique sense of bonhomie for a New York City public school.

"We leveraged the common spaces to make them perform with maximum utility," says partner in charge Jeffrey Murphy. "Linking the gym, cafeteria, lobby, and playground creates a bigger space for school-wide activities and community events," he adds. An extra-wide 13-foot corridor (the SCA standard is 8 feet) with quartz-topped window seats manages spillover, doubles as a waiting area for visitors, and aids traffic flow when kids are entering or exiting the building.

Daylight and the judicious use of color contribute to the atmosphere of well-being. "We used the sunken gym as a light well around which a lot of things circulate," says Murphy. "Even when the kids go downstairs, they can look up, see the street and know where they are." Similarly, each of the upper floors is color-coded to help wayfinding—green on the second floor, orange on the third, blue on the fourth—with colorful patches of vinyl tile and matching bench tops adjacent to the expansive windows that flank the halls on every level.

Comfortably settled in their school for over a year now, the students enjoy vistas of the park during class time and can watch planes landing at LaGuardia Airport from the library. They can even see Manhattan on clear days from the building's west side. "They love it," says principal LaShawnna Harris, "especially the kids who were in the old building."

The families are just as enthusiastic, she notes. "They're really excited to be able to see what's going on with their kids. We are constantly getting parents, especially at the beginning of the school year, who line Northern Boulevard in the morning and stay for 30 minutes just watching the kids in the gym or walking down the hallway." ■





WINDOW WALLS
Grade classrooms are on the building's quiet south side, where louvers outside the windows deflect glare and solar heat gain (opposite) and upper operable glazing units provide unobstructed child-height vistas. A built-in bench on the blue-themed fourth floor looks onto a mobile by Terence Gower that hangs in a double-height area of the library (left and bottom, right). Prominent display cases and large portholes on the doors enliven the upper floors, such as the orange-themed third floor (bottom, left).





PHOTOGRAPHY: © TY COLE (OPPOSITE); CHUCK CHOI (3)

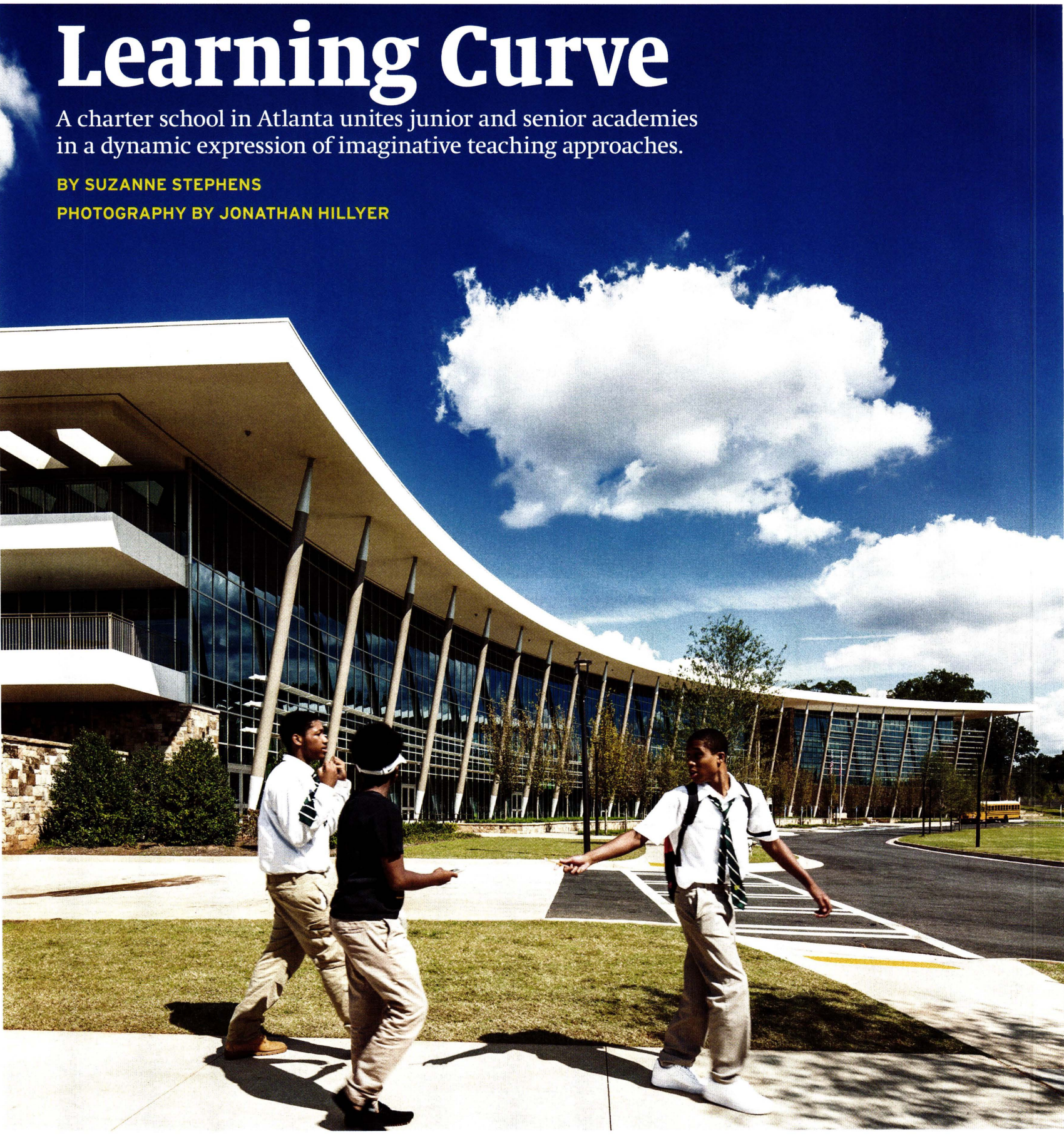
Charles R. Drew Charter School | Atlanta | Perkins+Will

Learning Curve

A charter school in Atlanta unites junior and senior academies in a dynamic expression of imaginative teaching approaches.

BY SUZANNE STEPHENS

PHOTOGRAPHY BY JONATHAN HILLYER





WINGSPREAD
The new school stalwartly proclaims its educational ambitions with a curved structure facing south and west. Balconies on the west end (opposite) look toward the Atlanta skyline; on the east end (above) Tennessee fieldstone defines end walls and amphitheater seating.

Expansively spreading across the rise of a hill, the crescent-shaped Charles R. Drew Charter School for Junior and Senior Academies proudly embraces its pastoral campus near downtown Atlanta. "Curving the building was obvious, with this setting," says Manuel Cadrecha, design principal of Perkins+Will (P+W), the architects. The 39-acre site, where groves of loblolly pines and bald cypress dot the landscape, is located near the Villages of East Lake, a mixed-income rental community, and the early-20th-century East Lake Golf Club, as well as the nine-hole Charlie Yates Golf Course.

The confluence of educational, housing, and golf facilities for a diverse population provides an interesting example of private and public communal revitalization. In the postwar decades, affluent homeowners began to desert the East Lake neighborhood (and the golf club), quickened by the construction in the 1970s of a nearby housing project stigmatized for its drug traffic. In the 1990s, Thomas G. Cousins, one of the city's leading developers, stepped in. Often said to have inspired Tom Wolfe's take-charge protagonist in his 1998 Atlanta saga, *A Man in Full*, Cousins turned the golf club into a corporate-member philanthropic enterprise. Then he worked with the community to create the mixed-income village that would replace the crime-ridden public housing project. In 2000, Cousins's East Lake Foundation helped create the first Charles R. Drew Charter School, for pre-K-8 (now pre-K-5), designed by Smallwood, Reynolds, Stewart, Stewart.

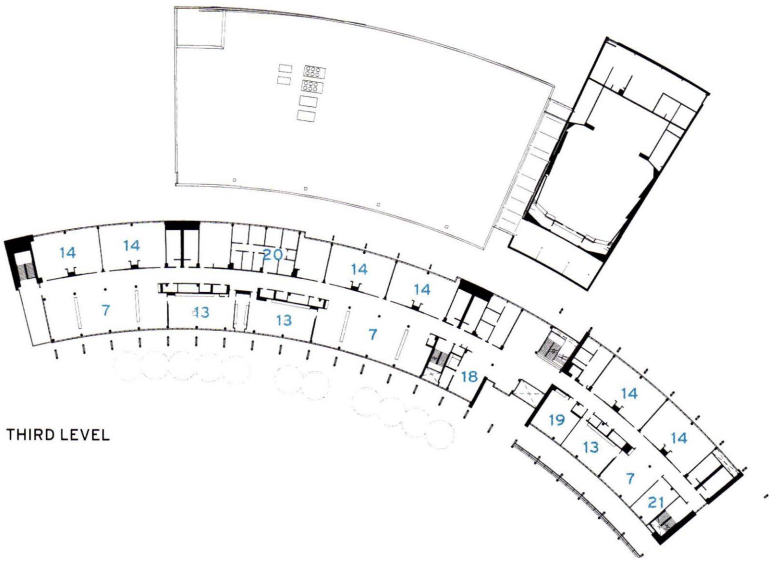
In August 2014, the foundation followed with the bracingly bold structure by P+W for grades 6 through 12—junior- and senior-level college-prep academies—just up the hill from the elementary school. The optimism of the mission to educate an underserved demographic can be seen in the architectural treatment: the upper school's narrow 83-foot-wide classroom building accommodates classrooms, labs, studios, and offices in its 577-foot-long arcing form. Canted pencil-shaped steel columns with tapered cones increase in height toward the east end where the roof gently lifts upward. Ample amounts of ochre-tinged Tennessee fieldstone define the monumental entrance portal and end walls of the concrete-frame structure.

The concave facade faces south and west, where a glass curtain wall is sheltered from the sun by a deep overhanging concrete canopy and horizontal, louvered aluminum sunscreens. "We did so many solar studies," says Barbara Crum, P+W principal in charge, noting that the architects and the school wanted to have as much daylight as possible within the teaching spaces, laboratories, and common areas.

At the back of the curvilinear building, slightly higher on the ridge, two separate, concrete–block and steel-frame wedge-shaped structures house the theater/auditorium and two gymnasiums. Because of the slope, a linear plaza in front of the theater and gym allows students to enter the main building's atrium at the second level.

The spatially fluid plan and the generous expanses of glass inside and out emphasize the school's commitment to a flexible curriculum, where educational activities can be easily viewed by faculty, students, and visitors. "The transparency of the spaces and the open plan help foster the program of collaboration and project-based learning," says Peter McKnight, principal of the senior academy. McKnight refers to the teaching method in which teams of students tackle problems based on real-life situations. Rather than emphasizing traditional rote learning, the school encourages its students to think critically, communicate, and create

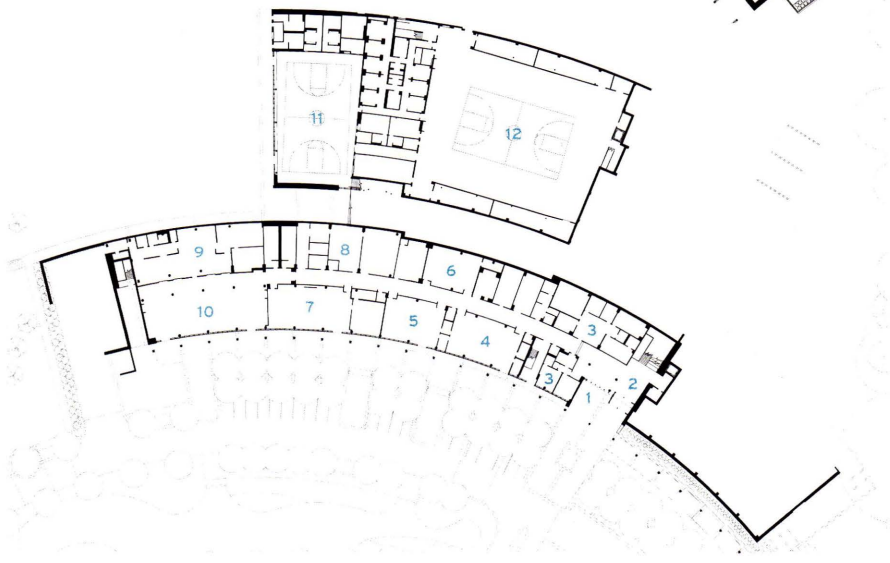
View additional images at architecturalrecord.com.



THIRD LEVEL



SECOND LEVEL



FIRST LEVEL

0 60 FT.
20 M.



1 RECEPTION
2 LOBBY
3 OFFICE
4 BAND
5 CHORUS
6 ORCHESTRA
7 CAREER TECH LAB
8 SERVICES
9 KITCHEN
10 CAFETERIA
11 PRACTICE GYM
12 GYM
13 SCIENCE LAB
14 CLASSROOM
15 AUDITORIUM
16 DANCE/MULTIPURPOSE
17 RUNNING TRACK
18 MEDIA CENTER
19 TEACHER PLANNING
20 STUDENT SERVICES
21 RESOURCE

credits

ARCHITECT: Perkins+Will – Barbra Crum, principal in charge; Manuel Cadrecha, design principal; John Poelker, project manager; Chad Stacy, project designer; Neda Ghani, project architect; Leo Alvarez, landscape design principal

ENGINEERS: Pharr Engineering Associates (civil); Uzun+Case (structural); Newcomb and Boyd (m/e/p)

CONSULTANTS: Arpeggio (acoustical); WorkingBuildings (sustainability)

GENERAL CONTRACTOR: JE Dunn

CLIENT: Charles R. Drew Charter School

OWNER: East Lake Foundation

SIZE: 205,000 square feet

CONSTRUCTION COST: $45 million

PROJECT COST: $55 million

COMPLETION DATE: July 2014

SOURCES

CURTAIN WALL: Kawneer

GLASS: Viracon

ACOUSTICAL CEILINGS: Armstrong, Hunter Douglas

RESILIENT FLOORING: Forbo

ELEVATOR: ThyssenKrupp

FURNITURE: Steelcase; Greystone



SEEING AND BEING SEEN In the lobby of the main building, stadium stairs of reclaimed white oak allow students to meet and work (above). In the recreational facility (opposite), stairs edging the dance space lead down to a practice gym. A parallel outdoor stair functions as the western termination of the plaza-like street separating the convex rear elevation of the main building from the gym and theater facilities.



through collaboration. The focus of the school on science, technology, engineering, arts, and mathematics (STEAM) can be seen in a project where ninth- and 10th-grade students worked with two teachers, one in engineering, the other in business technology, to make a remote-control lawn mower for a physically challenged resident who lives nearby. A recent cross-disciplinary assignment involving the visual arts and geography investigated subjects such as street art in the Middle East, while a mathematics and biology study called for designing a community health station.

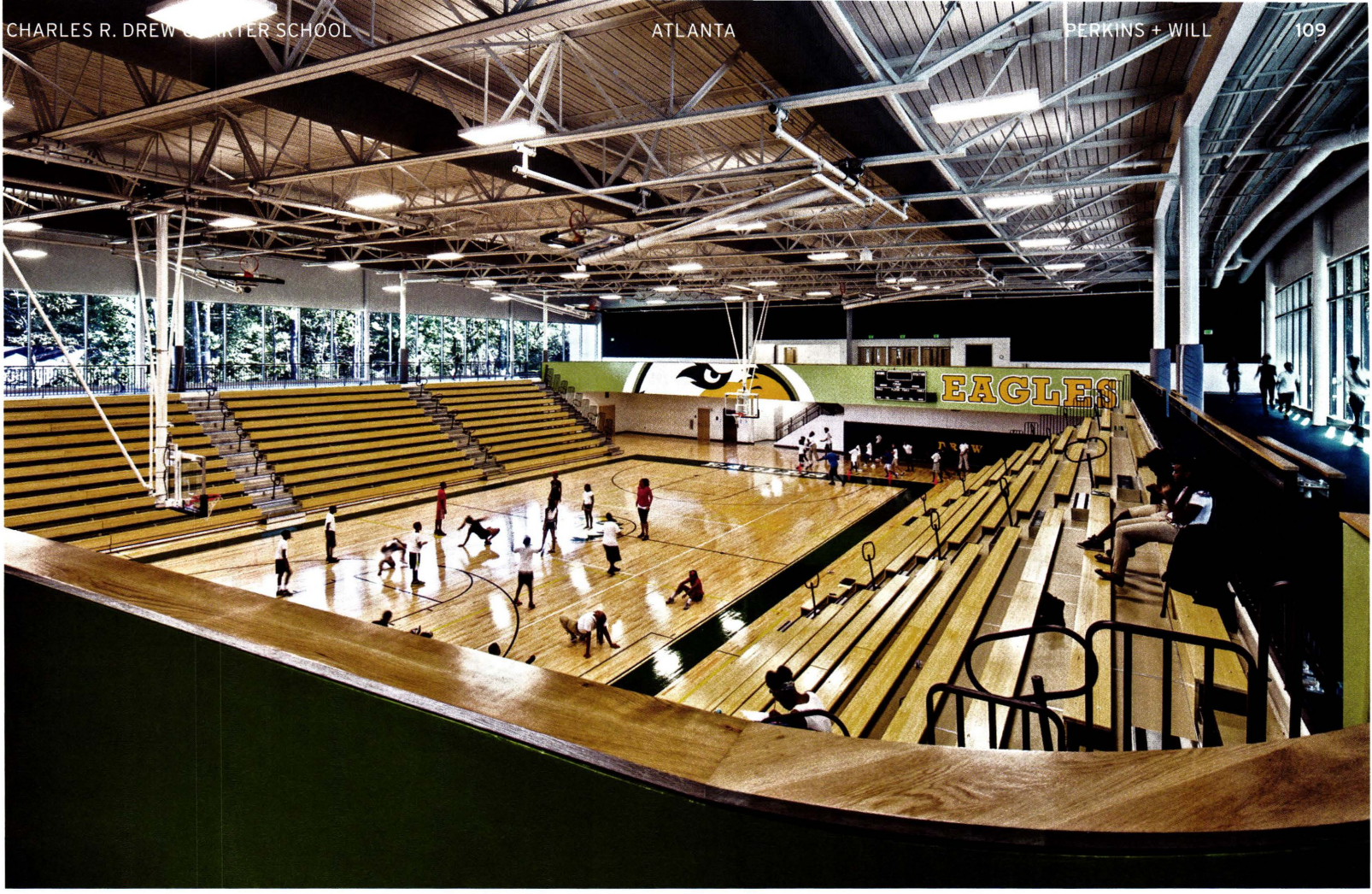
To foster these new approaches to teaching and learning, the architects created open project labs for groups of 24 students, fitted with rolling chairs, wireless networks, and access to water and power. Presentation areas with flat-screen monitors are common, while noise is mitigated by hanging panels between beams of the exposed ceiling. "We like to reveal the structure to show students how buildings are made," says P+W project manager John Poelker. Resilient flooring also cuts down on reverberation of school sounds.

A large, four-story atrium and stair with stadium seating at the main entrance acts as the lobby and circulation linchpin for the 205,000-square-foot school, separating the junior academy (currently 366 students) on the eastern end from the senior one (with 201 students) on the west. (The top floors for 11th and 12th grades remain unoccupied, awaiting lower grades to move up.)

Drew is seeking a LEED Gold certification with such sustainable components as high-performance glass, occupancy sensors to regulate electric lighting, reclaimed white oak, and local stone. Additionally, the design includes 180 photovoltaic panels on the theater building's roof that contribute to electricity supplies, a mechanical system based on a self-contained water-cooled unitary device (SWUD), and the harvesting of rainwater for irrigation.

The students seem to be responding well to the architecture of space and light and the sense of openness. One, Anastasia, said, "It's nice to have all the glass," pointing out that "the classrooms are unique and the common areas flexible." However, Amaya, another student, noted, "It's distracting when all the people on tours are staring at us while we are working." Such are the problems with success. It has become an educational mecca. ■

LET THE SUN SHINE Instructional spaces, such as the project lab (above) for the junior academy, are flexible (aided by mobile chairs) and accommodate about 24 students. Views of the surrounding landscape are prevalent within the heavily glazed interiors, which allow daylight into the gymnasium (opposite top). While the auditorium (opposite, bottom) has no windows, the backstage area (not pictured) has expansive views to the outdoors.


EAGLES





Garden School | Beijing | OPEN Architecture

Branching Out

A sprawling high school on the outskirts of China's capital connects students to environmental issues and offers a progressive approach to teaching.

BY CLARE JACOBSON



PHOTOGRAPHY: © SUSHENGLIANG

OUTSIDE IN The 622,000-square-foot school was designed to encourage students to congregate outside on wide stairs and in garden areas.



At Beijing's Garden School, students can sit on outdoor stairs to hear lectures, gather for talks along an open-air corridor, and plant vegetables on the roof. "Confucius taught under a tree, and Louis Kahn taught his students on the lawn," explains Huang Wenjing, partner at Beijing-based OPEN Architecture. But designing a Chinese high school to promote out-of-classroom teaching seems a radical idea. Strict building codes and a historically rigorous educational system typically produce standardized schools with a running track as the only outdoor space. But OPEN's competition-winning design, employed by an enlightened administration, offers opportunities beyond the chalkboard.

Garden School—officially Beijing No. 4 High School, Fangshan Campus, a suburban satellite of the downtown Beijing No. 4—is named for the six gardens set between the building's many fingers. Each has its own character: one is a wide lawn ringed by benches, another is a bi-level space with a grove of bamboo. All sit atop pieces of the 622,000-square-foot building. To fit the broad program on an 11-acre site and adhere to height restrictions, OPEN put some large spaces—cafeteria, auditorium, music rooms, dance studio, and parking—partially or wholly underground. The spaces above respond to the construction below. For example, one garden is equipped with wooden seating with transparent glass panels that transmit sunlight to a basement gymnasium.

The largest green space is a vegetable garden on the building's roof deck. The school currently has only 180 of its planned 1,000–1,200 students enrolled, but when it fills up, each of its 36 classes will tend their own plot. In the school's first months of operation, one class planted an experimental garden, and local farmers tended the rest of the plots.

All this attention to the school's outdoor space does not come at the expense of its interiors. Aboveground, the building appears as a lively asymmetrical structure with a central trunk for circulation and eight branches holding classrooms, labs, and administrative offices. Large windowed forms project from various branches and provide flexible spaces for relaxing and socializing. Similar projections extend from a detached dormitory that houses the senior high school students (junior high students live locally).

The school is spatially dynamic. Its main lobby—accessed from the street through a long, low gate and across a large plaza—may look convoluted in plan, but works well as a link to various stairways and levels. The classrooms themselves are simple boxes, but other spaces assume bold shapes. The library, for example, stretches out as a long, curving volume, while the cafeteria is an expansive, dome-shaped room. Sculptural stairways make walking among seven floors interesting (only the teachers can use the elevators).

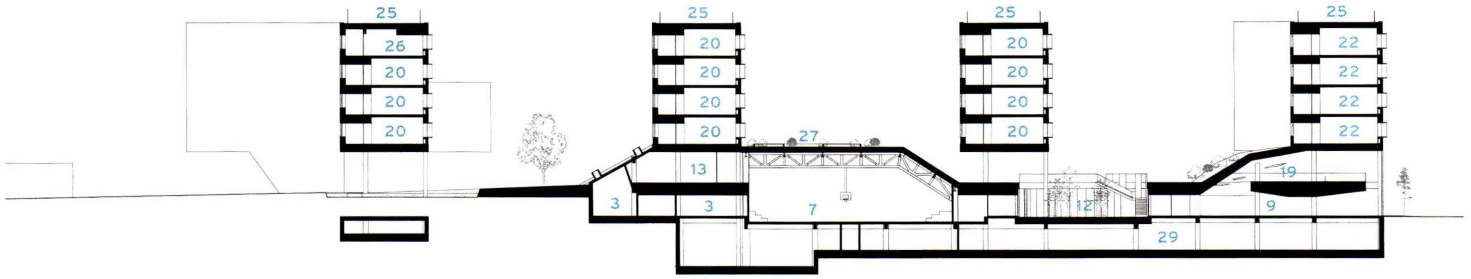
Details too are well conceived, such as the simple fluorescent tubes set in a hexagonal pattern and the multimedia equipment closets composed in Mondrian-like grids. Colorful igloo-like pavilions dot the central spine, offering spaces for music, relaxing, and other activities.

Of course, it is one thing to design indoor and outdoor spaces with flexibility in mind and quite another for them to be used effectively. Garden School Principal Huang Chun says that while it may be inconvenient for educators to use unconventional spaces, the unfamiliar can stimulate

BURIED RESOURCES To fit an extensive program on the 11-acre site and create a range of outdoor spaces, the architects pushed facilities such as cafeteria, music rooms, and parking underground. From the first mezzanine level (opposite), teachers can access their cafeteria, and students can walk down curving stairs to a bamboo garden. Covered stairs on the classroom wings and wide steps along the track (above) connect students with the outdoors.

PHOTOGRAPHY: © SU SHENGLIANG; XIA ZHI (OPPOSITE)





SECTION A - A

1 ENTRY
2 LOBBY
3 WORKSHOP
4 STORAGE
5 AUDITORIUM
6 MECHANICAL
7 GYMNASIUM
8 ROCK CLIMBING
9 STUDENTS' CAFETERIA
10 KITCHEN
11 BICYCLE PARKING
12 BAMBOO GARDEN
13 MUSIC
14 OFFICE
15 DANCE
16 LECTURE
17 TEACHERS' LOUNGE
18 DORM
19 TEACHERS' CAFETERIA
20 CLASSROOM
21 EXHIBITION
22 LAB
23 ACTIVITY SPACE
24 PAVILION
25 FARM
26 LIBRARY
27 GARDEN
28 OUTDOOR ACTIVITY SPACE
29 PARKING

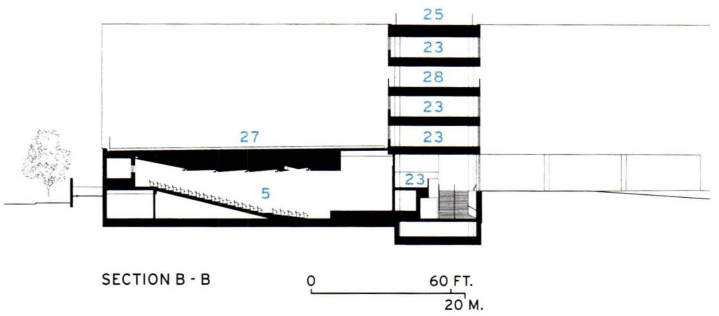


LEARNING TREE The design of outdoor stairs on the classroom wings (above) echoes in section the branching pattern of the school's floor plans (opposite, far right).



FIRST FLOOR

PHOTOGRAPHY: © SU SHENGLIANG



SECTION B - B

0 60 FT.
20 M.

credits

ARCHITECT: OPEN Architecture – Li Hu, Huang Wenjing, partners in charge; Daijiro Nakayama, project architect

ASSOCIATE ARCHITECT: Beijing Institute of Architectural Design

ENGINEER: Beijing Institute of Architectural Design

CONSULTANTS: School of Architecture, Tsinghua University (sustainability); Inhabit Group (curtain wall)

GENERAL CONTRACTOR: Zhongxing Construction

CONSTRUCTION MANAGER: Vanke + Cofco

CLIENT: Changyang Government of Fangshan District, Beijing

SIZE: 622,000 square feet

CONSTRUCTION COST: withheld

COMPLETION DATE: August 2014

SOURCES

EXTERIOR STUCCO: Hempel China

GLASS: Shandong Yaohua Glass

RESILIENT FLOORING: Shengtehuake Rubber

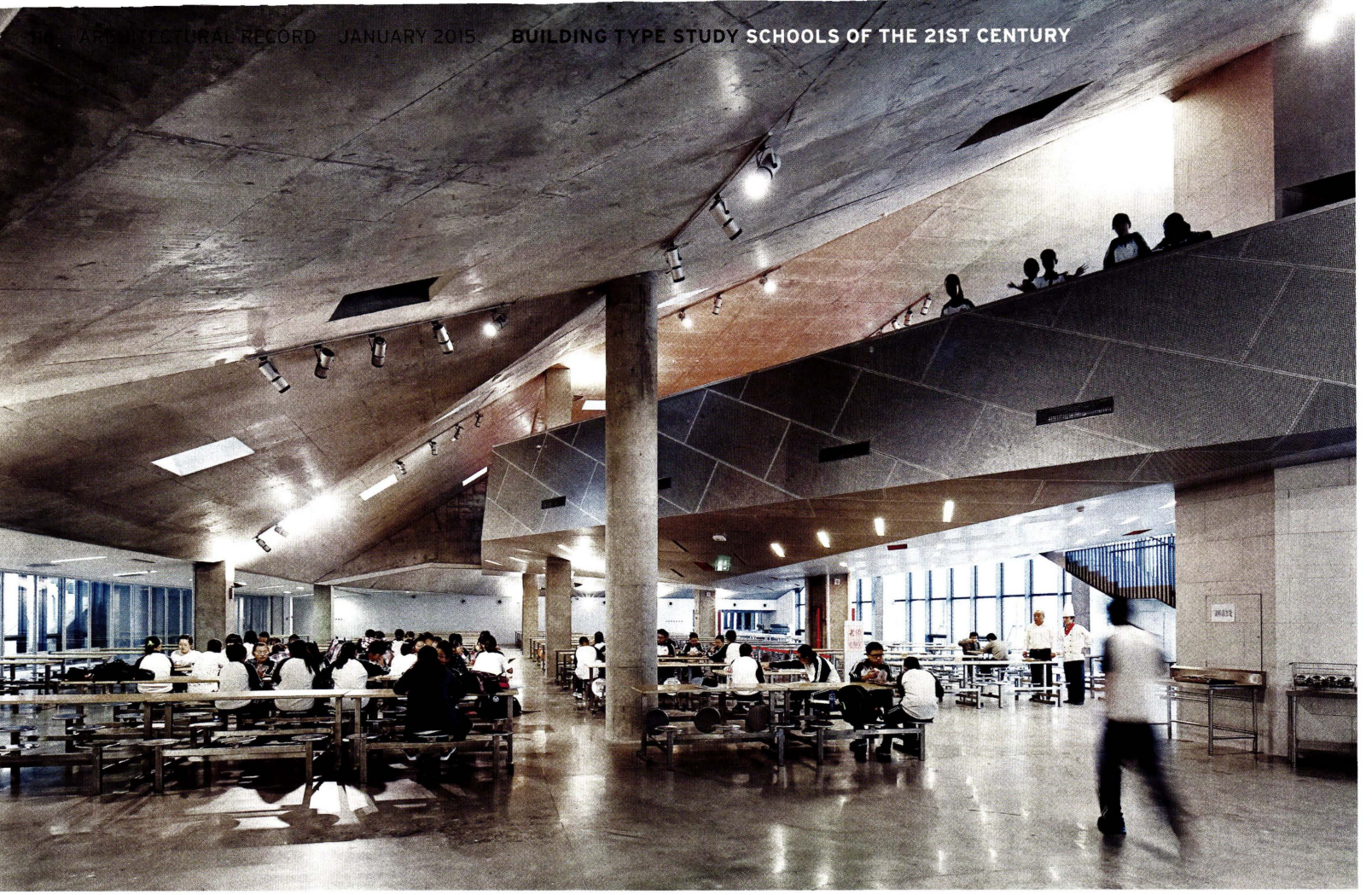
INTERIOR AMBIENT LIGHTING, DOWNLIGHTS: PAK



FIRST FLOOR MEZZANINE



SECOND FLOOR



MATERIAL CONNECTION
A simple palette of exposed concrete, aluminum panels, and bamboo kept costs down. Although partially underground, the student cafeteria (above) stays bright thanks to skylights and a glazed perimeter. A concrete stair (right) acts as a sculptural element. Wood paneling warms up the gym (opposite, bottom). Colorful partitions create social spaces in wide activity corridors (opposite, top).



PHOTOGRAPHY: © SU SHENGLIANG (TOP); XIA ZHI (3)

creative teaching. He and his faculty are still exploring how to exploit the school's architecture for teaching opportunities, following the philosophy of its progressive model, Beijing No. 4's esteemed program on its main campus. Already one section of a wide corridor is home to small craft stations for woodworking, terrarium-making, and textile arts.

The school is part of the Changyang new town in Beijing's Fangshan District, beyond the fifth ring road. OPEN principal Li Hu credits developer Vanke—which built the school for the city and has developed residences in the area—with encouraging sustainability. In addition to its gardens and planted roof, the school includes a geothermal heat pump, rainwater retention basins, and other green features. The school is awaiting China 3 Star designation, which would make it the first school in the country with this top green rating.

OPEN designed Garden School to be a good neighbor. Students' parents can use the library, and plans call for the community to have access to the dormitory swimming pool. An 800-seat auditorium with a separate entrance is available for non-school events. In November, principals from around China gathered there to discuss the teaching methodology of Beijing No. 4 and learn how to create a school that supports it. "During its 100-year history, Beijing No. 4 was always the avant-garde in education in China," says Principal Huang. "Now it is the avant-garde in campus design." ■





Intrinsic Charter School | Chicago | Wheeler Kearns Architects

An Old Frame for New Ideas

A series of structures that once comprised a lumberyard is transformed into an innovative school for grades 7 to 12 in a northwest Chicago neighborhood.

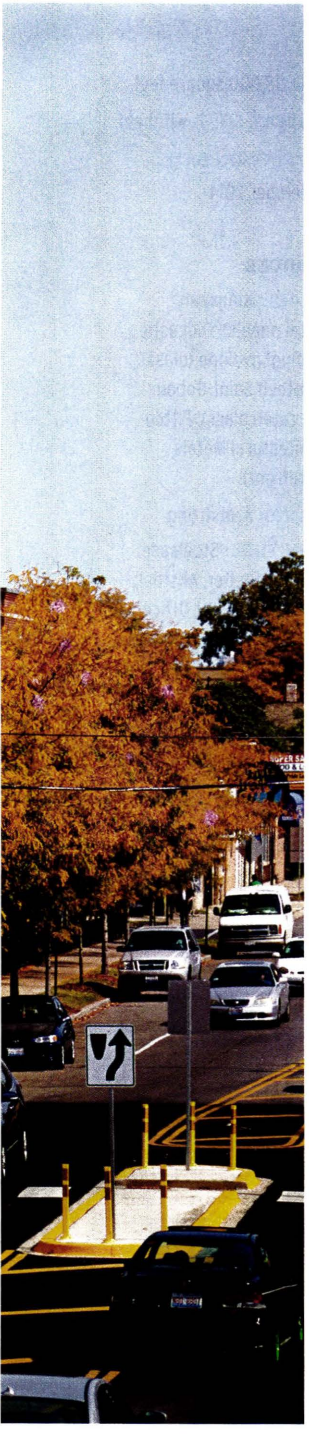
BY CATHLEEN MCGUIGAN

PHOTOGRAPHY BY STEVE HALL FOR HEDRICH BLESSING



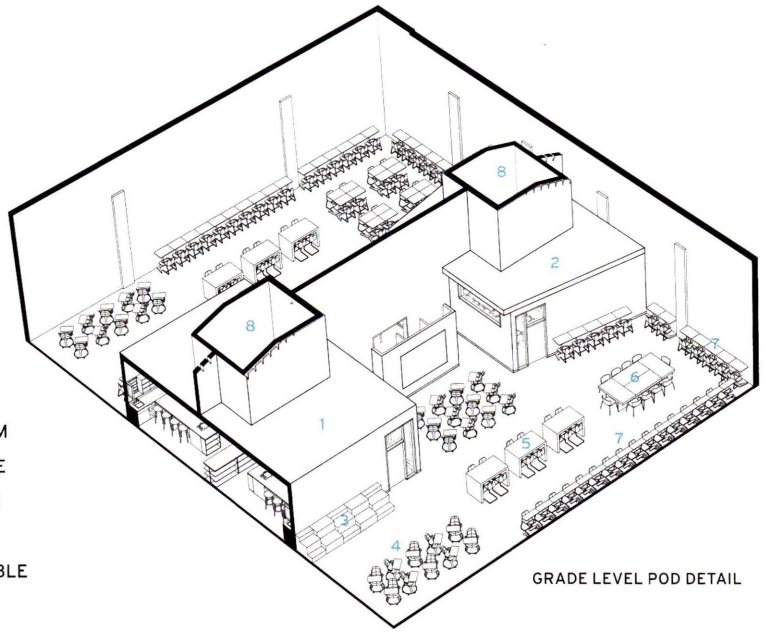
When Melissa Zaikos, founder, CEO, and principal of the Intrinsic Charter School in Chicago, was looking for a site for the new school, she visited the former Shannon Lumber Company on West Belmont Avenue in the northwest section of the city. "I fell in love with the barn when we walked in," she recalls of the bowstring truss structure (once an open shed) with solid wood columns that rise as high as 30 feet. Constructed in 1954, it is the northernmost extension of two connected structures built in 1911 and 1928, for a family-owned lumber business, that seemed far more suitable to adapt for Intrinsic's innovative curriculum than a traditional school building. With a blended learning program, Intrinsic employs a unique classroom configuration. "The school is designed particularly to this model," says Larry Kearns, principal of Wheeler Kearns Architects, the firm that transformed the commercial building into the new facility.

Kearns and his team began by razing a caretaker's house-cum-sales-office at the southern end of the complex, and replacing it with a steel-frame structure. This was linked to the gutted buildings to create a school that is 456 feet long





CUSTOM-MADE
The exterior is now clad in insulated metal panels, while the main entrance lobby (right) employs towering original solid wood columns, with steel braces that act like splints for support.



GRADE LEVEL POD DETAIL

POD DETAIL

1 LABORATORY
2 SEMINAR ROOM
3 STUDY LOUNGE
4 POP-UP CLASS
5 GENIUS BAR
6 EXCHANGE TABLE
7 COASTLINE
8 SKYLIGHT

credits

ARCHITECT: Wheeler Kearns Architects – Lawrence Kearns, project principal; Danny Wicke, project architect; Jon Heinert, Joey Gamblin, Joey Lippe, project team

ENGINEERS: Enspect (structural); McGuire Engineers (m/e/p/fp); Terra Engineering (civil/traffic)

CONSULTANTS: Wolff Landscape Architecture (landscape); Threshold Acoustics (acoustical)

GENERAL CONTRACTOR: Clune Construction

CLIENT: Intrinsic Schools

SIZE: 58,000 square feet

PROJECT COST: withheld

COMPLETION DATE: September 2014

SOURCES

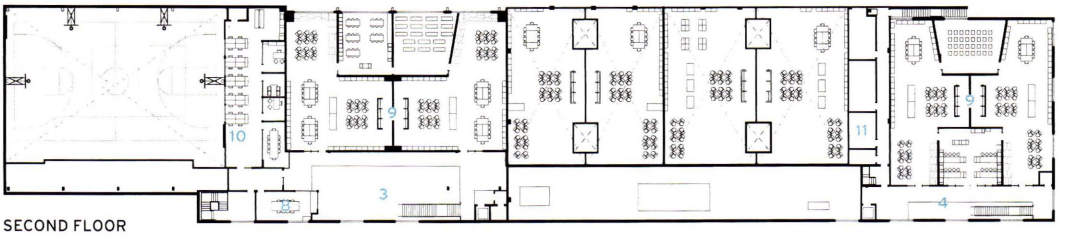
FACADE: Kingspan (metal panels); Oldcastle BuildingEnvelope (glass); Vetrotech Saint-Gobain (fire-rated glass); Pittco Architectural Metals (storefront)

CEILING: Armstrong

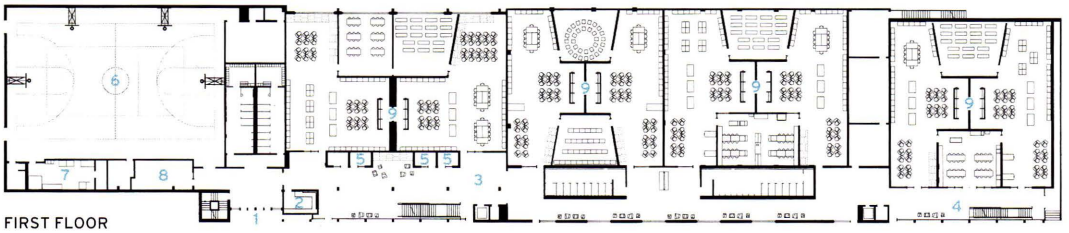
FURNITURE: Steelcase, Vanerum Stelter, Allsteel, HON, Leland, First Office

FLOOR PLANS

1 ENTRANCE
2 RECEPTION
3 NORTH ATRIUM
4 SOUTH ATRIUM
5 HUDDLE ROOM
6 GYM/MULTIPURPOSE ROOM
7 WARMING KITCHEN
8 LEARNING LAB
9 GRADE-LEVEL POD
10 ADMINISTRATIVE OFFICE
11 STAFF ROOM



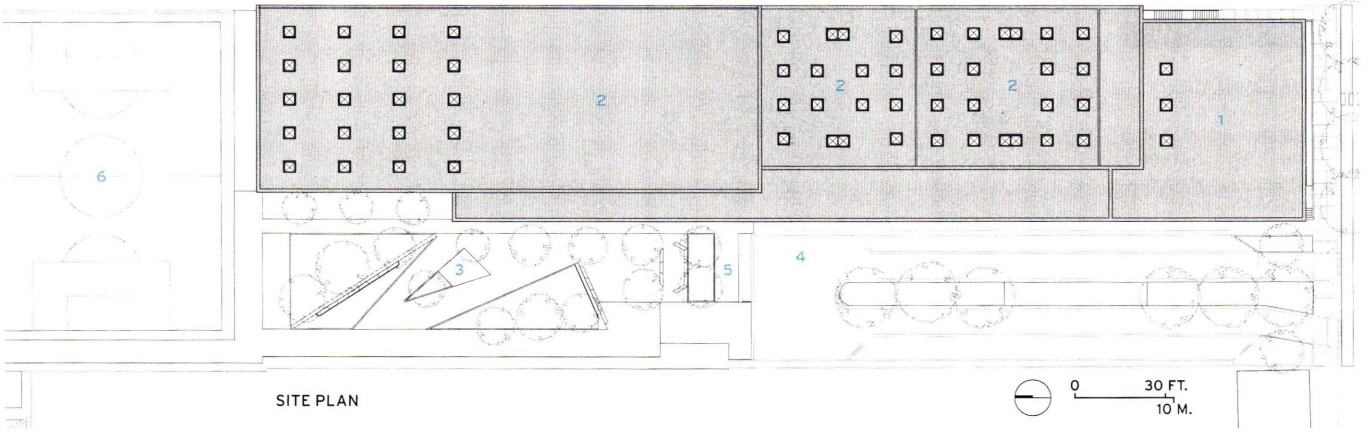
SECOND FLOOR



FIRST FLOOR

SITE PLAN

1 NEW CONSTRUCTION
2 RENOVATED EXISTING BUILDING
3 ENTRY PLAZA
4 VEHICULAR DROP-OFF AREA
5 BICYCLE PARKING
6 TURF PRACTICE FIELD



SITE PLAN

0 30 FT.
10 M.



LIGHTEN UP
New windows, integrated with the checkerboard pattern of the metal panels, bring in daylight primarily along the south and west walls (left and below).

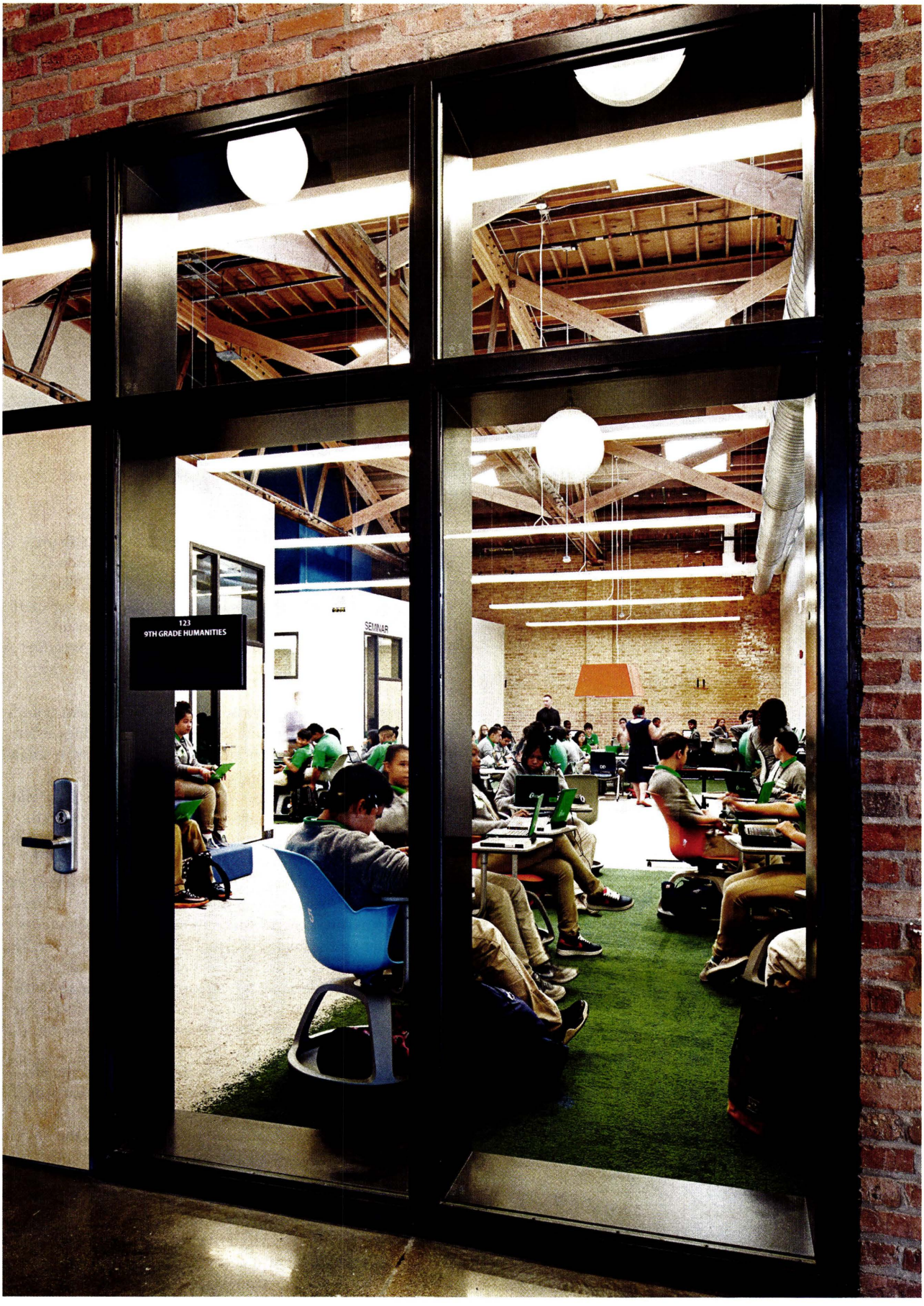


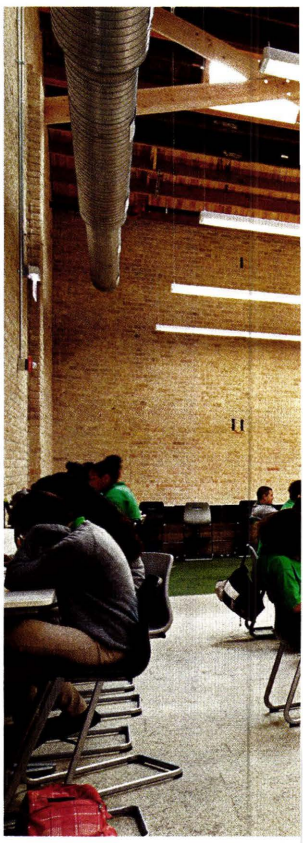
and 94 feet wide, with a roof covered by insulating foam, an exterior clad in insulated metal panels, and windows installed primarily on the west and south facades. The existing structures have brick bearing walls with long-span roofs and bowstring trusses (though the 1928 structure's wood trusses had been replaced with steel joists). Because of its length, the building was subdivided into three fire zones with separate exits.

Founded in 2013, Intrinsic moved to its permanent home last fall. With a capacity for 925 students from grades seven through 12, it is currently occupied by 430 students. A single-loaded corridor along the west wall dominates the long interior with ample glazing, while double-height spaces and single-story stacked zones are arrayed along the east wall. The hallway has polished concrete floors and clusters of soft, colorful seating for informal gathering or group work.

The central design feature is the unusual classrooms along the east wall. Called "tandem pods," these are pairs of large, linked rooms, one pair for each grade of up to 180 students. One pod per pair is for science, math, and technology studies; its twin is for humanities. Students rotate among various blended-learning methods, which integrate technology with peer-to-peer or teacher-led instruction. Along the walls is the "coastline"—counter-style desks where students wearing headsets work individually on digital lessons using Chromebooks—while elsewhere in the room, students on rolling chairs can come together for small-group learning. Other students gather under a big orange pendant at the "exchange table" to work on team projects, or they meet with a teacher at a central counter or "genius bar" (with apologies to Apple). An enclosed seminar room and a lab, for more conventional teaching, are tucked in between the pods. Up to eight teachers work with students in each pair of pods.

The architects learned from the innovative school's early trials. For example, the students used rolling chairs at its temporary campus: "The student groupings looked like bum-





POD TIME
While creating innovative classrooms (left and above), the architects recycled 75 percent of the existing structures—the original bowstring trusses are exposed in the gym (opposite, bottom) and elsewhere—and employed numerous other sustainable strategies and materials.



per cars at a carnival," says Kearns, "and brought chaos." Now the "coastline" and exchange tables have stationary seating.

One big design challenge was bringing daylight to the pods. Along most of the eastern edge of the building, on the property line, the architects were not able to punch in windows. Instead, the tandem pods draw daylight through the interior glass that fronts the windowed corridor, and five of the 12 pods incorporate high-performance skylights. "We needed dispensations from the city for the borrowed daylight and to use skylights," says Kearns.

In the "barn" that had so attracted Zaikos, the architects built what they call "a ship in a bottle": a two-story steel-frame structure, inserted in the 1954 building's south end, that contains a tandem pod stacked on each floor and administrative offices on the second level overlooking the gymnasium. The 38-foot-high gym, with the exposed bowspring truss, also flexes as a cafeteria—with mobile tables—as well as a community space that can be isolated from the academic areas at a common entry vestibule.

With a design tailored to the highly individualized curriculum, it might seem as if Intrinsic would be a free-for-all. But students were orderly as they lined up in the corridor—two ninth-grade girls in green polo shirts (each grade wears its own color) declared the school "really strict!" The level of student autonomy, particularly in the lower grades, is limited and continues to be tuned. Says Zaikos, who plans to open more schools on this model, "The building is important to learning about the learning." ■



Ergolding Secondary School | Ergolding, Germany | Behnisch Architekten and Leinhäupl + Neuber

Round the Clock

A longer school day prompted the client and architects to rethink the way education is delivered in Germany and how it is housed.

BY MARY PEPCHINSKI

PHOTOGRAPHY BY DAVID MATTHIESSEN





German schools traditionally close at 1 p.m., but to accommodate working parents, the *Ganztagsschule* or all-day school has emerged in recent years. The longer hours are prompting a rethinking of school design, not only to increase energy efficiency and create healthy environments but also to explore how architecture can enable students to relax and stay productive throughout the extended day.

The Ergolding School, which can accommodate 80 teachers and 800 students in grades 5 to 12, focuses on science and economics. As designed by Behnisch Architects and Leinhäupl + Neuber, the project points German education in the direction of all-day learning. Here students can attend classes that end at 1 p.m. on most days and can elect after-school supervision until 4 p.m. up to four days a week—or they can participate in a program offering morning and afternoon classes. The concept requires auxiliary spaces, including a cafeteria for midday meals and after-school study halls, not usually found in German high schools.

Located in Ergolding, 40 miles north of Munich, the school sits between a highway on the south and a nature preserve and a school for children with special needs on the north. The north-facing entry leads to a four-story atrium that connects diverse ground-level functions—cafeteria, music, and sport facilities to the east, and offices, teacher preparation rooms, art studios, library, and study halls to the west. Extensive interior glazing throughout the ground level, combined with the spacious atrium, establishes a progressive approach: "It's different from a typical school," notes Ewald Bichler, assistant principal and a teacher. "Being so open and bright makes it easier to engage with students."

To help with navigation, each level is distinguished by a single color applied to flooring and walls in corridors and restrooms—yellow for the ground floor, orange for the second, green for the third, and blue for the science departments on the fourth. Classrooms are accessed by south-facing corridors, which serve as thermal barriers and a buffer against the highway. The corridors' exterior windows feature triple-glazing, with a frit to reduce solar heat gain.

The classrooms, which face north, also have triple-glazed windows to provide day-long, balanced light to improve concentration. On the second and third levels, louvers on the corridors' interior facade direct additional daylight across these spaces and through a clerestory into the rear of the classrooms, while domed skylights enhance illumination on the fourth. LED luminaires supplement daylight in classrooms, all public areas, and the gymnasium.

Areas for informal communication or quiet retreat are

OPEN BOOK Extensive glazing lets people see inside the 147,000-square-foot school, so the local community feels connected to it. The building's central atrium, which serves as a hub for student activities and can be used for public meetings, is expressed on the exterior as a projecting volume with a double-height entry. A sense of transparency both inside and out is important to the school's identity.



dispersed throughout the building. The architects designed leftover spaces resulting from the plan's irregular geometries as gathering areas. They also widened corridors fronting the art studios, library, and study halls to encourage social interaction, and enlarged low-lying window sills to become benches that entice students to linger.

Ventilation, heating, and cooling systems take advantage of the generous corridors, which vary in width from 8 to 10 feet. Supply air is directed mechanically into the classrooms and can be supplemented by operable windows. Exhaust air is directed through the corridors to the atrium, where it is removed. A heat pump, which harvests warm air from a geothermal field north of the school, supplies 85 percent of the school's heating needs. (A gas-fueled boiler delivers the remainder.) Also, hot or cold water runs through the concrete ceiling slabs to help heat or cool interiors.

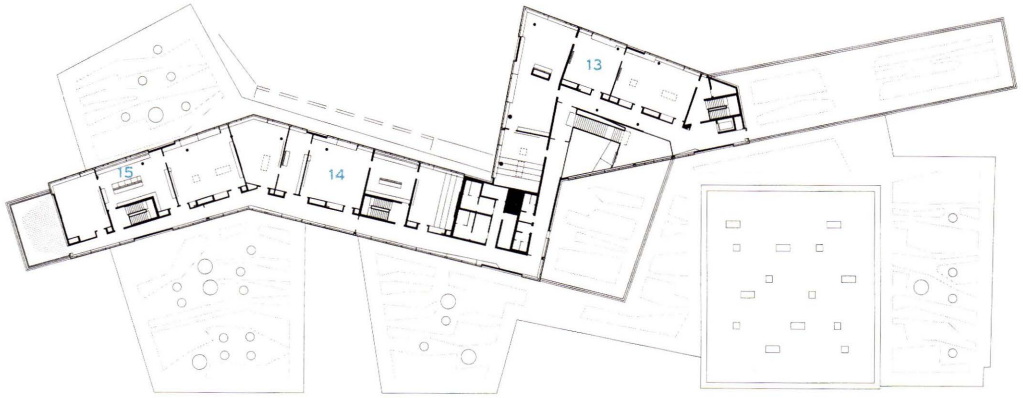
Far from being an ivory tower, the school welcomes use by the surrounding community. Outside groups, such as children from the adjacent school, access the gym by a separate entry on the east, and the sports hall and changing rooms can be open independently of the rest of the school on evenings and weekends. Non-school events can be held in the atrium, which is an officially designated place of public assembly. And because the building won't reach full capacity



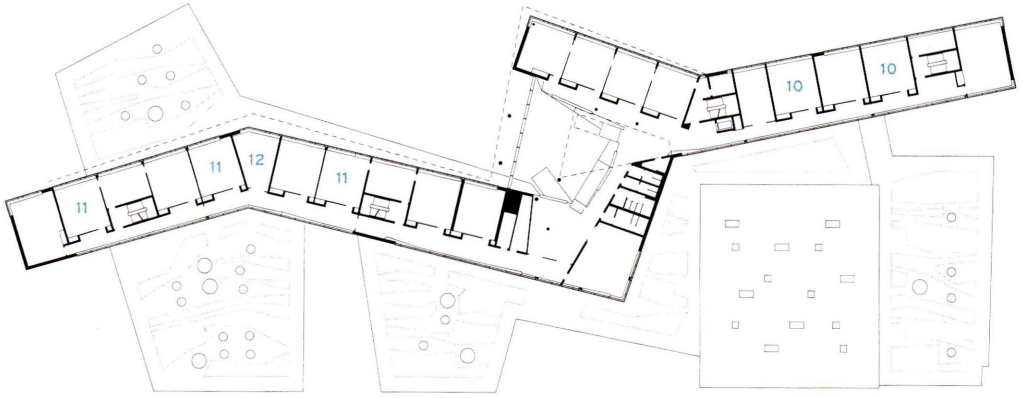




HANGING OUT
Much of the school was designed to encourage students and staff to interact on an informal basis in spaces such as the central atrium (opposite) and decentralized learning spaces (above). Skylights and color make even circulation spaces (left) attractive, while aiding wayfinding as well.



FOURTH FLOOR



THIRD FLOOR

1 ENTRY
2 ATRIUM
3 CAFETERIA
4 GYMNASIUM
5 MUSIC
6 LIBRARY
7 OFFICE
8 ARTS
9 AFTER-SCHOOL
10 CLASSROOM
11 CLASSROOM (ALL-DAY SCHOOL)
12 DECENTRALIZED LEARNING
13 PHYSICS
14 CHEMISTRY
15 BIOLOGY



GROUND FLOOR

until 2019 (currently it is occupied only by grades five to seven), underutilized classrooms can be used for conferences and other outside activities.

The school's proximity to the highway is its only drawback. Though it goes unnoticed indoors, and a new sound-absorption barrier offers some protection, the traffic's din nevertheless penetrates the small, south-facing courtyards opening onto the gym, art rooms, and library.

The school hums with life. During a midday visit in November, the atrium recalled a busy town square, with students piling book bags at the base of the generous stairs, some playing intently at table football, and others poring over study sheets at small tables clustered near the cafeteria, which serves almost as a sidewalk café. According to Klaus Wegmann, the Ergolding School's principal, the building's transparency and informality benefit the students and also affect the staff: "The openness makes a difference," he says. "We have more cordial relations, and many people use the familiar form of 'you.' This school is clearly not for more straitlaced types." ■

Berlin-based Mary Pepchinski is a writer, architect, and professor of architecture at the University of Applied Sciences in Dresden.

GOOD NEIGHBOR
Many of the school's facilities, including the gymnasium (below) are available at certain times to the local community and can work independently of the rest of the building. The central atrium can be used for public events, and classrooms that aren't occupied yet by students can host conferences.

credits

ARCHITECTS: Behnisch Architekten – Stefan Behnisch, Robert Hösle, partners in charge; Brigitte Hoernle, project leader

Architekturbüro Leinhäupl + Neuber – Markus Neuber, Barbara Neuber, Peter Leinhäupl, partners in charge; Paul Rapp, project leader

ENGINEERS: BBI Bauer Beratende Ingenieure, ISP Scholz Beratende Ingenieure (structural); Frey-Donabauer-Wich (mechanical/environmental); TRANSSOLAR Energietechnik (energy)

CONSULTANTS: Nimbus Group (lighting); lab landschaftsarchitektur (landscape)

CLIENT: District of Landshut

SIZE: 147,000 square feet

CONSTRUCTION COST: $19.2 million

COMPLETION DATE: September 2013

SOURCES

ALUMINUM-MULLION TRANSOM FACADE: Wicona

STEEL-MULLION TRANSOM FACADE: Raico

GLASS: Glas Trösch

SKYLIGHTS: Börner Oberlicht Kuppeln



Sequoyah School Expansion | Pasadena, California | Fung + Blatt Architects

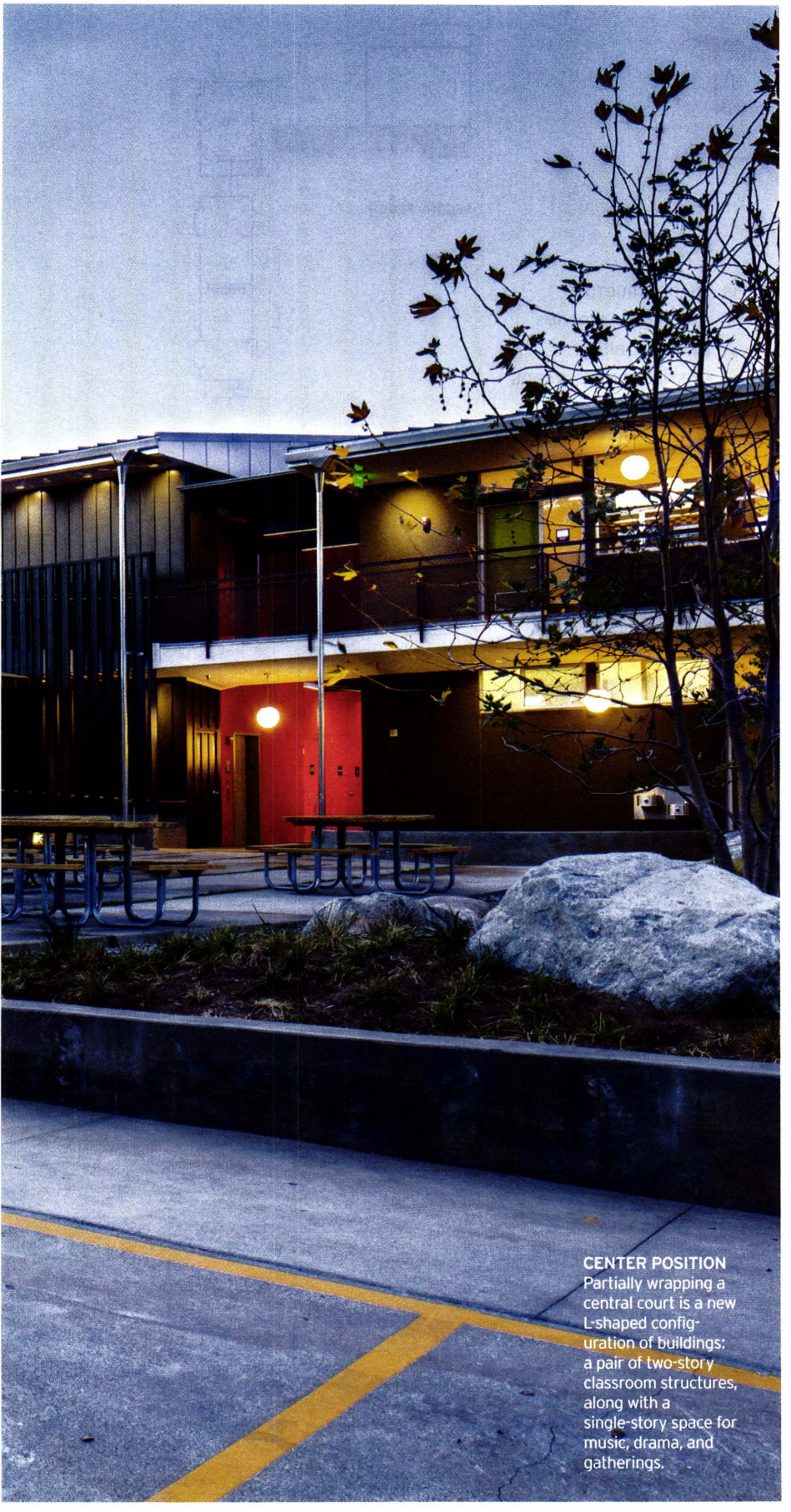


Haven off the Highway

Located near a major freeway, a school becomes an unexpectedly protected and inviting enclave for learning.

BY SARAH AMELAR

PHOTOGRAPHY BY PENTAPRISM STUDIO



CENTER POSITION Partially wrapping a central court is a new L-shaped configuration of buildings: a pair of two-story classroom structures, along with a single-story space for music, drama, and gatherings.

True to the collaborative spirit of the progressive Sequoyah School, in Pasadena, California, its students played active roles in the recent architectural changes on campus. Architects Alice Fung and Michael Blatt asked the pupils at this independent K-8 school to list their "wild dream" improvements and prioritize their needs. Their input had impact: Fung + Blatt Architects' (F+B) initial intervention here, in 2009, was a shaded pick-up/drop-off shelter, addressing a top priority of its users. The architects also tackled small projects, gradually weaving together the eclectic campus, before transforming a long-overlooked section with new buildings.

Instead of disrupting learning, the multi-phased design work inspired it, engaging students, for example, in mapping and analyzing the existing campus. In Sequoyah's "place-based" pedagogy, its surroundings are fodder for learning.

But the site—a 2.25-acre parcel between a freeway off-ramp and a major artery—is not an obvious spot for a school. Sequoyah leases its campus from Caltrans, the state highway agency, yet the school has flourished here for decades, striking a balance among seemingly irreconcilable conditions.

Originally, it was the site of an 1887 shingle-style church. In the early 1950s, California modernists Smith and Williams added Sunday-school buildings and a children's chapel, with grounds by Garrett Eckbo. In 1958, the newly founded Sequoyah School became the church's part-time tenant, occupying those classrooms the rest of the week. The design's flexible space and flow between indoors and out dovetailed with Sequoyah's philosophy. Amid trees, breezeways, and brise-soleils, each classroom was given its own yard, in addition to communal gathering spots.

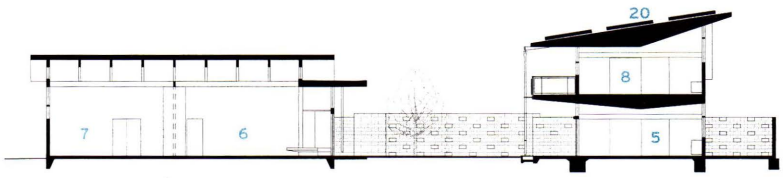
But paradise was soon imperiled as the state planned to run the 710 Freeway through the site. California's Division of Highways eventually acquired the campus through eminent domain and, in 1974, bulldozed the church. Though the surviving buildings were, until recently, slated for demolition, the school stayed on as the tenant. Forty years after the church's demise, the freeway extension remains unrealized, largely due to community opposition. If completed, it will probably tunnel beneath this neighborhood.

With that likelihood, Sequoyah embarked on its own much-needed transformation, knitting together the mix of midcentury and shingle-style components within a new perforated-steel perimeter enclosure, designed by F+B to replace Caltrans's sagging chain-link barrier. "This completely changed public perception of the school," says Fung. "It was a very smart, even strategic, move—demonstrating a stewardship of the campus that will, I hope, help Sequoyah purchase the property when it eventually comes on the market." (Caltrans will presumably offer the campus for sale if it proceeds with its underground alternative.)

And it's an enclosure with transparency. "Community is really important to us," explains Sequoyah director Josh Brody. "We wanted to convey that and also create inspiring gathering places, where we could hold events for students, parents, even the larger community." That aspiration, coupled with Sequoyah's needs to provide performing arts facilities and expand its student body, from 190 to 250, led to re-envisioning a ragged end of campus, where trailers housed various school functions.

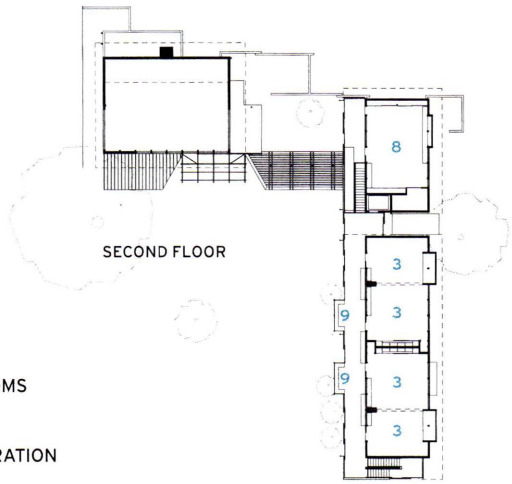
There, F+B formed an L-shaped configuration of three

View additional images at architecturalrecord.com.



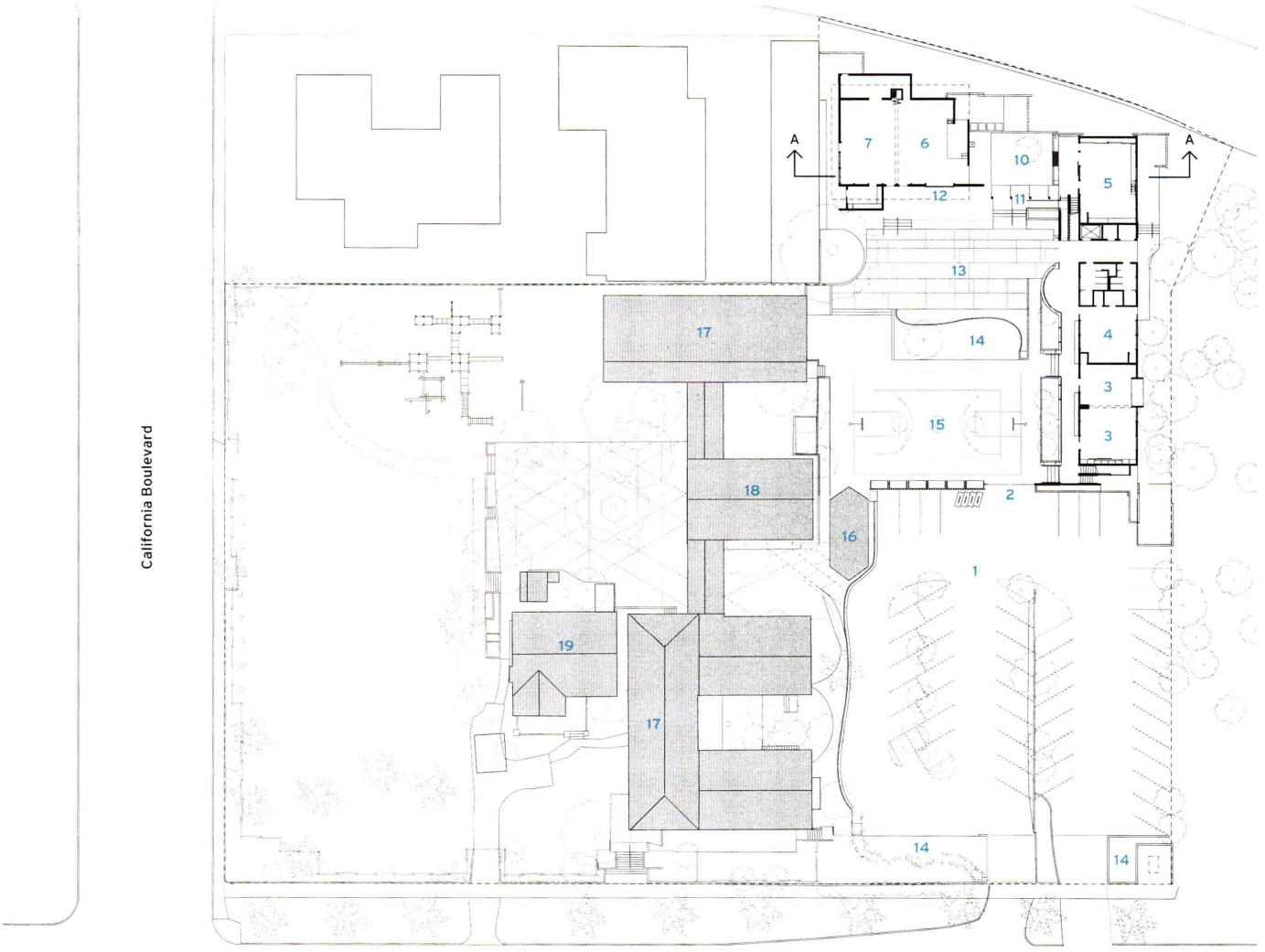
SECTION A - A

0 15 FT.
5 M.



SECOND FLOOR

1 PARKING
2 ENTRANCE
3 CLASSROOM
4 FLEX
5 ART LAB
6 THEATER/MULTIPURPOSE ROOM
7 MUSIC/MULTIPURPOSE ROOM
8 SCIENCE LAB
9 STUDY PODS
10 COURTYARD
11 CONCOURSE
12 OUTDOOR STAGE
13 PLAZA
14 RAIN GARDEN
15 EXISTING BASKETBALL COURT
16 SHADE STRUCTURE
17 EXISTING CLASSROOMS
18 EXISTING LIBRARY
19 EXISTING ADMINISTRATION BUILDING
20 PHOTOVOLTAIC PANELS



SITE PLAN / FIRST FLOOR

0 30 FT.
9 M.





ILLUMINATED IDEAS
Taking cues from the campus's midcentury buildings, the architects integrated light-filtering screens and gave each upper-level classroom its own outdoor space, or veranda (above and left). "Retaining lines of sight—flow and continuity with the old part of campus—was also important to us," says Sequoyah director Josh Brody.



buildings, backed against the freeway off-ramp to deflect traffic noise and carve out a large, protected court. The $2.8 million, 11,700-square-foot project created classrooms, a science lab, and venues for gathering, art, and performance.

Echoing the spirit of Smith and Williams's design, F+B took conceptual cues from its breezeways, light-dappling sunscreens, and airy, daylit classrooms. With inverted trusses, shallow-pitched roofs, and deep overhangs extending into high, canted ceilings, the new wood-framed buildings reinterpret midcentury features, translating them with materials including fiber-cement siding and concrete flooring. Like their earlier counterparts, the classrooms are spacious and versatile, with movable partitions, lofts, and smaller "learning pods" with their own outdoor verandas. Now art-making spills out onto a patio. A sliding panel opens the performing arts building, converting its indoor stage into an outdoor one. The students eat lunch together outdoors. "We had no idea there was this much space back here or that it could be this great," comments one eighth grader, sharing a typical reaction. And the sound-buffering buildings don't completely shun the freeway. Big classroom windows look straight down the traffic spine. As grade five-six teacher Art Phiffer explains, "There's a lot to learn from the freeway, and we will be studying it." ■



IN 'N' OUT
Lofts (above)—echoing those in Sequoyah's original buildings—are among the versatile features of the new classrooms. The "Infinity Room" (opposite), named by students, is the multipurpose performing space with a sliding barn door.

credits

ARCHITECT: Fung + Blatt Architects – Alice Fung, Michael Rosner Blatt, design principals; Chris Pilikyan, Matthew Scarlett, project team

ENGINEERS: Ming Yang Yeh & Associates (structural); Brandow & Johnston (civil); M-E Engineers (m/e/p)

CONSULTANTS: KornRandolph, Glen Dake (landscape); S.L. Leonard & Associates (construction manager)

GENERAL CONTRACTOR: AMG & Associates (expansion, 2013); Mission Development Consultants (perimeter fence, 2010); DTK Builders (shade structure, 2009)

CLIENT: Sequoyah School

SIZE: 11,700 square feet

CONSTRUCTION COST: $2.8 million

COMPLETION DATE: September 2013

SOURCES

MASONRY: ORCO Block & Hardscape

FIBER CEMENT SIDING: James Hardie

GLAZING: PPG; Oldcastle BuildingEnvelope

LIGHTING: Philips Lightolier

CLASSROOM FURNITURE: Contrax Furnishings

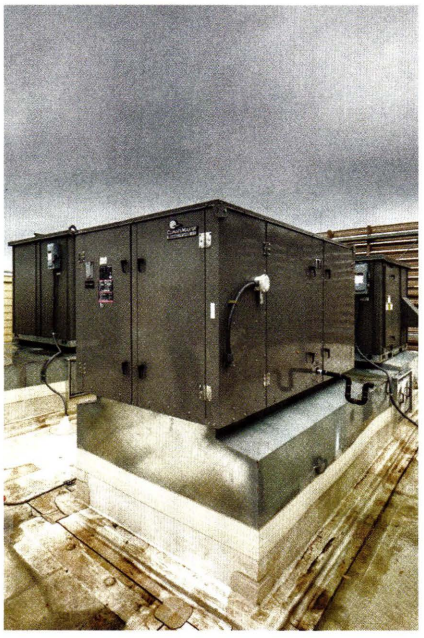
ACOUSTICAL CEILINGS: Tectum

Case Study

THE CHRISTINA SEIX ACADEMY, NEW JERSEY

CLIMATEMASTER





ABOVE: ClimateMaster Tranquility Rooftop (TRE) Series Units

LEFT: Christina Seix Academy, a USGBC LEED certified campus in Trenton, N.J., consists of 8 buildings on 64 acres.

THE CHRISTINA SEIX ACADEMY IN NEW JERSEY took its commitment to the community to great heights when it chose to build its eight-building, 64-acre campus, from the ground up, with sustainable materials and practices to meet the USGBC's LEED® certification standards. The Academy—which serves underprivileged youth in the Trenton-Ewing area living with a single adult caregiver—was funded by Christina Seix, a successful businesswoman, who also grew up poor and was raised by a single mother.

"We were very interested in putting sustainable building practices in place in order to help the school run incredibly efficiently," said Dr. Rob Connor, Christina Seix Academy head of school.

Working with Spiezle Architectural Group, the Academy designed a unique campus which boasts numerous cutting-edge technologies that promote efficiencies and conservation, ultimately providing benefits for the school, its students and the environment alike.

"The decision to pursue LEED certification is an elaborate process that requires all involved to weigh the costs and benefits of putting these practices into place and commit to them long-term," said Brian Eaves, project engineer with Spiezle Architectural Group. "Christina Seix Academy was very committed from the start, so we designed every building detail with comprehensive solutions that will help them save and conserve now and into the future."

This included specification of a state-of-the-art mechanical system employing renewable geothermal technology. The system, featuring water-source and geothermal heat pumps from ClimateMaster, includes 68 Tranquility® 20 Single-Stage (TSH) Series horizontal units, 5 Tranquility Rooftop (TRE) Series units, and 2 vertical Tranquility 20 Single-Stage (TSV) Series units.

Haddon Heights, N.J.-based mechanical engineering and design consulting firm Pennoni Associates Inc. initially recommended a closed-loop geothermal system to provide conditioning in all of the buildings.

"We looked at a number of HVAC systems and what we determined was that a closed-loop, vertical bore geothermal system would be most efficient," said Bob Mellohusky, MEP division manager and project engineer at Pennoni Associates. "That would be the backbone of the HVAC for the commercial buildings, in addition to accounting for the future needs of the residential facilities."

The final decentralized system design included five individual geothermal borehole fields with a 196-ton total capacity, and a total of 106 boreholes drilled to 350 feet.

Ground broke on construction of the Academy in May of 2011, and initial installation of the mechanical system by mechanical contractor West Jersey Air Conditioning & Heating Co. followed in the winter of 2011.

"For that volume of work, our interactions with ClimateMaster and their local representative Sass, Moore and Associates were very clean," said West Jersey Air Conditioning & Heating owner Keith Conroy.

Completed in September 2012, the Academy has already observed the energy- and cost-saving benefits of its geothermal heating and cooling system from ClimateMaster.

"The economic benefit was a huge motivating factor for us because it meant that we could direct more resources to our students, and in turn, serve more kids," said Connor. "We are pleased that this decision is already deriving the savings we expected."

SYSTEM SPECIFICATIONS

68 Tranquility® 20 Single-Stage (TSH) Series horizontal units

5 Tranquility® Rooftop (TRE) Series units

2 Tranquility® 20 Single-Stage (TSV) Series vertical units

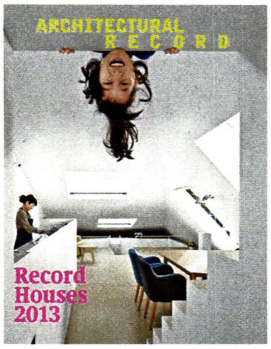
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CIRCLE 61



2015 Record Houses

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Good Design Is Good Business

CALL FOR ENTRIES

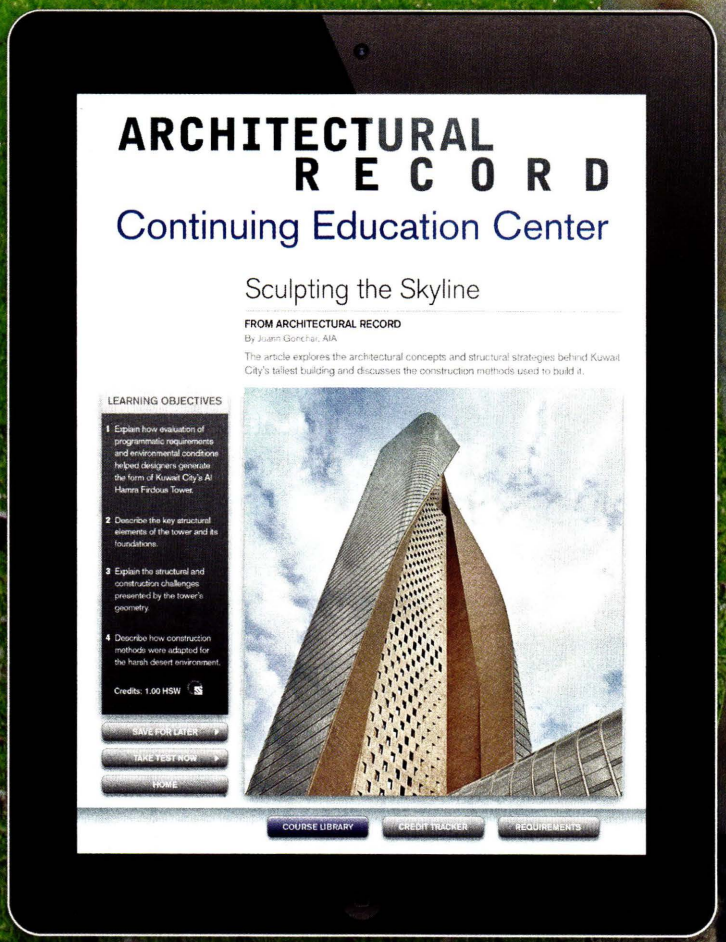
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The fee is US$150 per entry and $50 for each additional project. Download the official entry form at architectural record.com/call4entries. E-mail questions to arcallforentries@construction.com. Please indicate **GDGB** as the subject of your e-mail. SUBMISSION DEADLINE: **January 15, 2015.**



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Photo: Endicott Clay Products

School Buildings in 2015: Designing for Students

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PM RR SU

CREDIT: 1.5 HSW



Photo: REHAU North America

Fenestration Solutions for Efficiency and Performance

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CREDIT: 1 HSW



The Strong and Sustainable Solution for K-12 School Lockers

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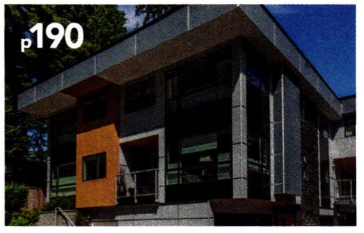
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Active Chilled Beams Come of Age

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BE PM SU

CREDIT: 1 HSW



Innovations in Aluminum Cladding Systems

Sponsored by Longboard – A division of Mayne Coatings Corp.

BE PM SU

CREDIT: 1 HSW

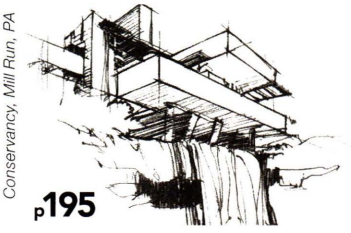


Image: Western Pennsylvania Conservancy, Mill Run, PA

Frank Lloyd Wright: American Icon, Architectural Master, Modern Dreamer

Sponsored by PPG Paints

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Photo: A&B Process Systems

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- **LS** LIFE SAFETY AND CODES
- **PM** PRODUCTS AND MATERIALS
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CIRCLE 23

Photo courtesy of Endicott Clay Products



Modern school design increasingly needs to address a variety of concerns related to the experience of students in and around those buildings such as Hunter's Point in Queens, New York, designed by FXFowle.

School Buildings in 2015: Designing for Students

Using multiple design strategies to create better learning environments in both new and existing K-12 school buildings

Sponsored by AGC Glass Company North America, Bison Innovative Products, CertainTeed Gypsum, DORMA, ELP Lighting, Endicott Clay Products, Guardian Industries Corp., Hussey Seating Company, KIMBERLY-CLARK PROFESSIONAL*, Mitsubishi Electric Cooling & Heating, NanaWall Systems, National Terrazzo & Mosaic Association, Nichiha USA, Inc., Pittsburgh Corning, Space Plus, a division of The Sliding Door Company, U.S. Concrete, and VS America | *By Peter J. Arsenault, FAIA, NCARB, LEED AP*

The design of K-12 school buildings has garnered a lot of attention in recent years, focused on ways to create genuinely better learning environments for students. Those involved in working with school boards, administrators, and teachers have no doubt engaged in discussions and debates over the need for optimized instructional spaces, healthier and safer buildings, reduced energy usage, better environmental integration, and other factors contributing to better student performance overall. These issues aren't limited to new construction since they are often primary drivers of modernization programs in existing school buildings as well. Fortunately, the interest in these issues has spawned some research and performance-based programs to help inform all those involved when it comes

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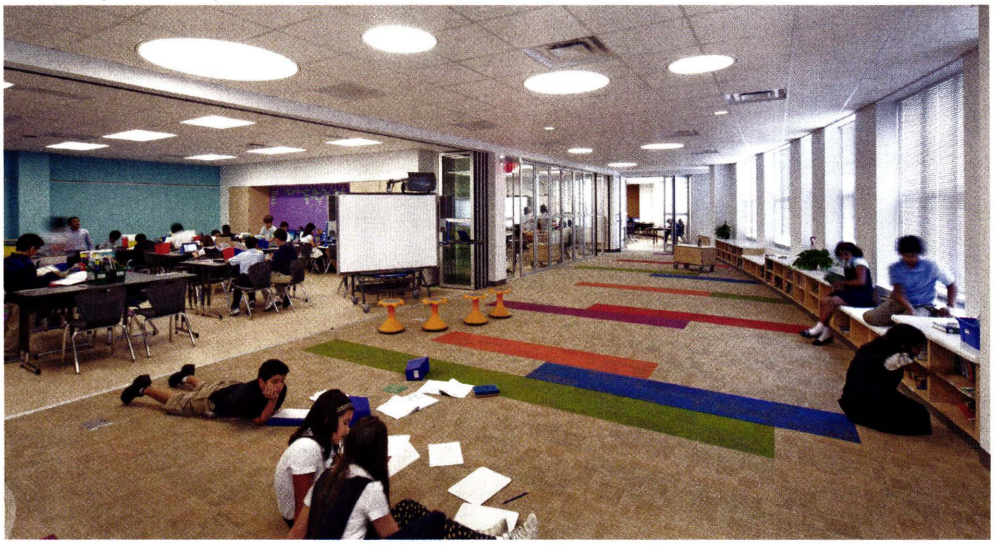
After reading this article, you should be able to:

1. Explore the basic condition of schools in the United States and the range of issues among the states related to new and existing school buildings.
2. Investigate six fundamental student performance concerns related to the design of school buildings.
3. Assess various strategies that can be used to successfully improve the quality of learning environments.
4. Recognize and identify programs and resources to assist in healthier, more productive, and more efficient learning environments.

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Movable walls provide flexible, collaborative spaces that enhance learning at the Booker T. Washington STEM Academy in Champagne, Illinois, by CannonDesign.

to making design decisions. This information allows architects to consider various available design strategies to help create truly effective, modern learning environments where students can flourish.

CONTEXT: SCHOOL STATUS AND TRENDS

Industry sources generally acknowledge that school construction is often the largest sector of total nonresidential construction put in place in any given year. An organization known as the 21st Century School Fund has founded a collaborative program known as Building Educational Success Together (BEST) that has reviewed and compiled information based on U.S. Census data, available state data, and direct surveys to document some specific details. In 2011, they published a summary of Public School Facility Infrastructure which indicates that nearly 90 percent of all of the 55.5 million school-age children in the U.S. attend nearly 100,000 public schools in the U.S. More precisely, they count 98,706 PreK-12 public schools (including 4,694 public charter schools) representing an estimated 6.6 billion gross square feet of existing space and over 1 million acres of land or site areas. Since the BEST focus is on the condition of these facilities, they cite a significant backlog of deferred maintenance and capital improvements on the order of an estimated $271 billion or approximately $4,883 per student. They further estimate that since 1999, an average of 80 percent of the capital outlay of school districts has been on new construction and additions with 20 percent on existing buildings.

Turning to future outlooks, other sources suggest that enrollment will continue to grow on the order of 2.5 million more students through 2018 with annual capital spending nationally projected on the order of $25 billion or more each year through then. Observable trends include a growth in school additions and renovation to help address potential overcrowding. There has also been a clear trend observed in school designs becoming more flexible and adaptable for changing demographic and classrooms needs. In response to incidents of violence and other security concerns, there has also been a growing effort to create schools that are safer.

Green and sustainable design has also been a significant, ongoing movement that is expected to continue in schools, creating spaces with more connection to the natural environment, more natural light, healthier indoor air, and better energy performance. This effort is boosted by programs such as the LEED® for Schools program from the U.S. Green Building Council (USGBC). A related USGBC effort is the national Center for Green Schools which helps educate designers and educators on specific characteristics for safe, healthy schools including a program to bring sustainability education into the classroom. In 2012, the Center for Green Schools partnered with the McGraw Hill Financial Research Foundation and published "The Impact of School Buildings on Student Health and Performance." It was based on a 2006 National Research Council report entitled "Green Schools: Attributes for Health and Learning." Both documents use six categories related to student experiences in school buildings and cite research studies as their basis. We will use the same six categories in the following sections to illustrate not only the connections between student performance and their surroundings, but also to suggest some potential design strategies and examples of their implementation. In all cases, the focus is on improving the conditions in which everyone involved can thrive.

1. HOW STUDENTS THINK AND LEARN

Connecting good school facilities with good student learning outcomes is a complicated proposition at best since there are many building variables and many human variables that can come into play. Nonetheless, there have been some observational studies that have produced some promising findings. For example, a study in one school district in Connecticut found that student test scores increased notably in schools after school construction projects were undertaken. (Neilson and Zimmerman, 2011.) The researchers accounted for differences in socioeconomic levels and other confounding factors to reach their conclusions so it is reasonable to infer that some direct correlation exists between the improved conditions and student test taking, although they cite the need to undertake a larger study on a national scale. Other observational studies have connected environmental factors with students' abilities to be fully alert or simply attend classes, both of which have obvious direct impacts on learning.

So what general design strategies would help students be more alert, or simply more engaged to think and learn better? The trend for more flexible spaces may play directly into this. If a learning environment can be easily and readily adapted to meet the particular needs of a grade level, a specific class, or even a particular student, might it not follow that their engagement with the environment directly facilitates engagement with learning?

Movable Walls

One strategy is to incorporate movable wall systems instead of purely fixed walls into the design of a learning area to create a truly dynamic and flexible learning environment. Opening a movable wall can create a shared space between two adjacent classrooms while closing the wall can separate and isolate them when needed. Similarly, movable wall systems can open up multiple classrooms or grades to a common area that is shared for group learning activities. This design strategy offers the benefits of allowing the same spaces to be used for smaller project-based learning activities or for larger common exercises where students work together on a range of activities, utilizing shared resources such as technology centers and presentation areas. Creating such flexible classroom configurations can optimize limited floor space, allowing for potentially less square footage and reduced construction costs. In addition, such multi-use spaces can contribute to reduced operating costs since teachers can share resources, cross-collaborate, and create a more efficiently run school.

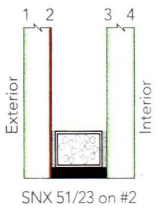
This movable, flexible wall approach was employed at the Booker T. Washington STEM



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CIRCLE 24

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Flexible and movable furniture systems empower both teachers and students to create classroom environments that directly suit the teaching and learning needs of a particular class for different subjects or activities.

Academy in Champagne, Illinois. Serving 225 students, the school is separated into three academies with each grade further stratified into three learning studios which share a communal gathering space. The architectural firm of CannonDesign determined that the use of movable glass wall systems allowed the three studios to either function as separate learning environments or to open up and share the larger communal space. As observed by Stuart Brodsky, AIA, LEED AP, an associate principal at CannonDesign, "The movable glass walls enable multiple room configurations and sizes without building additional space. This flexibility allows teachers to gain access to shared resources and adapt space for small and large groups as well as project-based learning activities." They also allow each learning studio to maximize activities within the communal gathering and project workspace—what CannonDesign calls a "piazza for discussion and collaboration." This open-plan layout is meant to mirror professional settings, helping students prepare for real-world future collaborations.

Creative Classroom Furnishings

For students to learn and think in a classroom setting, the furnishings that they use need to work with their learning styles and the teaching style of the instructor. In addition, all furniture has become increasingly focused on good ergonomic design using environmentally friendly materials and manufacturing processes. Recognizing these needs, the school furniture industry has responded in dramatic fashion, offering unique combinations of seating, work surface, and storage options that enable the end users to effectively and efficiently create their own environments. This design strategy is not about reinventing the classroom as much as it is about blending historic educational values and strategies with flexibility and creative learning environments. The end goal remains the creation of healthier, higher-performing learning environments so the selection of furnishings should reflect that goal. It should be noted that there are lines of educational furnishings that directly respond to the principles and design guidelines of USGBC, the Center for Green Schools, and other such national programs.

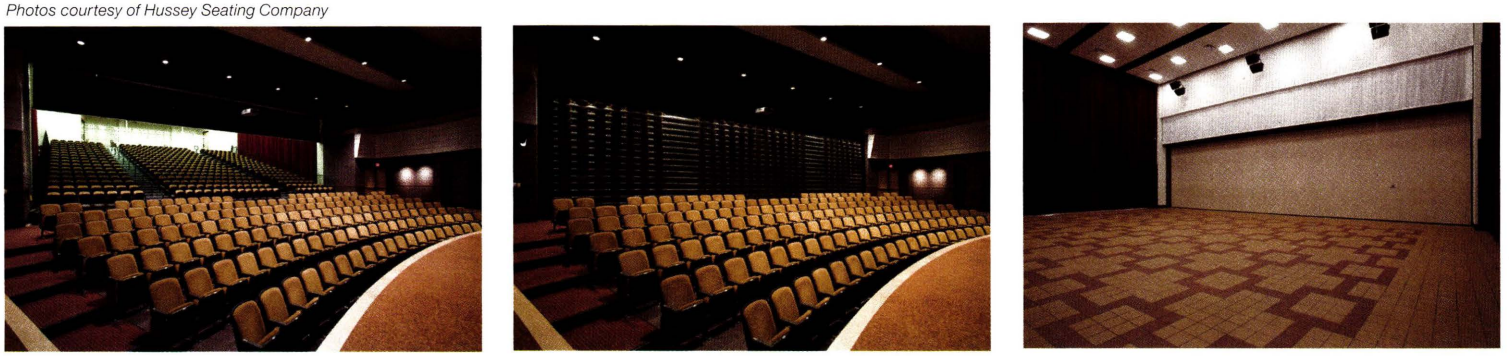
The impact on design from flexible furniture systems means that classrooms don't need to be restricted to a planning process based on rows of desks alone. Rather, the room becomes an enclosure that allows for variable forms and shapes to promote class-wide learning or separation into smaller groups within the classroom. When these new and variable environments are created, it is possible to think in terms of a holistic approach to design and how it fits with educational goals and styles. According to David A Stubbs II, owner of Cultural Shift and the designer of Shift+, when teachers and students are empowered to adjust, move, and otherwise rearrange the furniture to suit different needs, it has been observed that 100 percent engagement has occurred. This full level of engagement in combination with minimalized distractions, has been shown to demonstrate improved learning and more effective teaching strategies.

Seating in Multipurpose Spaces

Most K-12 school buildings require spaces for large group gatherings such as gymnasiums, cafeterias, and auditoriums. A common and favored strategy is to make such rooms serve multiple purposes since large gatherings for different reasons don't necessarily occur at the same time. The design challenge is found in creating a single room that can accommodate the different spatial and functional needs of those different uses. Further, a single large room may not always be used to capacity; in fact, it may be more desirable to allow several small groups to use portions at the same time.

A common design strategy for multipurpose spaces is to incorporate seating that is movable in some manner to allow greater flexibility in the use of the space. Telescopic seating has typically been used in school gymnasiums in the form of bleachers. However, it is also possible to use the telescoping concept with a platform system in a more contemporary manner with a variety of seating types for different comfort

Photos courtesy of Hussey Seating Company



A combination of fixed and telescopic seating creates a full auditorium (left). When the telescoping seating is closed, it creates a dividing wall and smaller auditorium on one side (middle) and a usable open area on the other (right).



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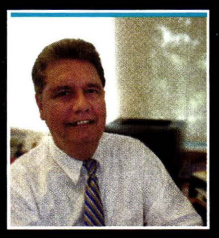
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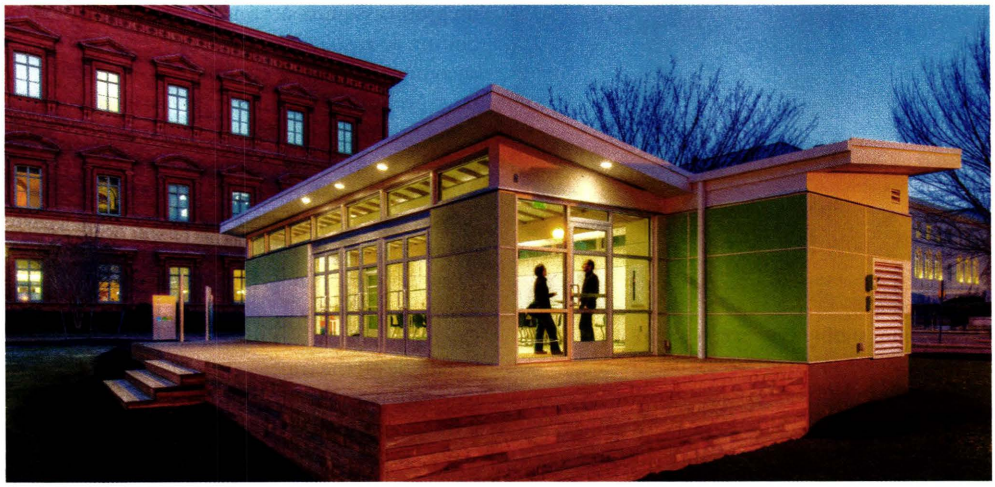


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Outdoor learning spaces with elevated decks and planters can be used on roof areas or on modular classroom structures like this one designed by Perkins+Will.

levels. When electrified, these telescoping systems can be operated easily by one person to convert gymnasiums or other spaces from open areas to seating areas. Adding the use of fully portable chairs, benches, or other seating allows even more opportunities to meet the needs of different student activities. Taking that one step further, "tip and roll" platforms can be moved into place to provide a presentation space or additional seating for particular activities.

Combining telescoping seating with fixed-in-place seating can provide other choices and options in how large group spaces are used. For example, in Michigan, the Whitmore Lake High School needed a large auditorium but they didn't need it all the time. They did need some smaller open spaces that could provide other functions while a smaller seating area in front of the stage area was sometimes adequate too. The solution was found in a rather innovative combination of seating types. In front of the stage, seven rows of stepped, fixed seating were installed. Behind that an area of telescoping seating on platforms was installed such that when open, it looked like a natural extension of the seating in the auditorium. However, by using a reverse folding operation, the closed seating forms a dividing wall between the fixed seating and the space otherwise occupied by the open seating. This approach allows that space to be used for other activities such as lunch, community functions, and classes. Having the flexibility in the way this space is used allows students to learn in environments suited to the activity.

Exterior Learning Spaces

Learning spaces don't need to be limited to indoor spaces. In fact there are a lot of creative ways that outdoor learning spaces can be incorporated into school designs to allow hands-on learning of outdoor focused subjects. In multistory schools, particularly in urban settings, rooftop decks and elevated deck areas provide a safe and structured area for students to learn, play, and enjoy the outdoors. Perhaps one of the biggest outdoor learning opportunities is to see how things grow in gardens. But when land area is not available, then planters can be used on top of outdoor decks to create the same opportunity. Finished, accessible outdoor spaces can be created by using wood deck systems that rest on adjustable screwjack pedestals to support and level modular wood deck tiles. Outdoor deck systems can also provide pedestrian access to other features such as planted green roofs for students to discover and monitor the benefits of that sustainable design attribute.

This strategy of including outdoor learning space in schools has been incorporated into a demonstration project carried out by the international design firm of Perkins+Will in conjunction with numerous sponsors. Recognizing the popular use of modular units to address school expansion needs, they have put together a healthy, sustainable, and flexible modular classroom designed to meet the needs of a 21st century classroom. In addition to addressing the range of interior design needs for students and teachers, they have included outdoor learning and garden patio areas as part of the basic design of the module. This garden patio allows students to interact directly with nature and the outdoors, rather than just reading about it or learning from electronic media.

2. HOW STUDENTS MOVE

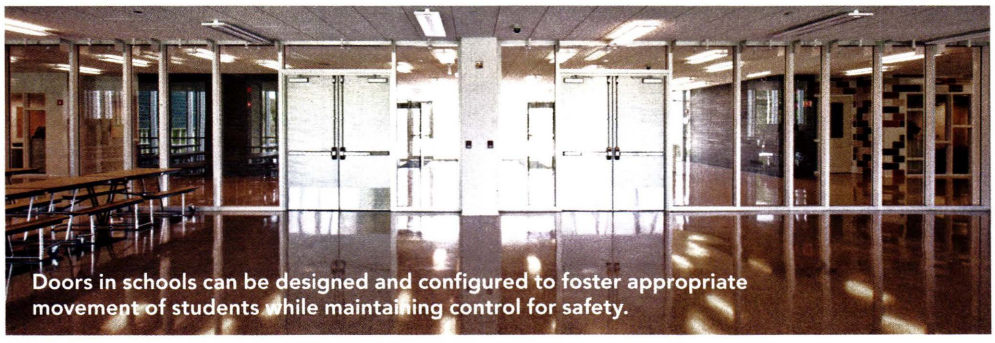
Students, teachers, staff, and visitors all move through a school building by walking—how much and how far is often a matter of design. In this era where only about 5 percent of all students walk or ride their bike to school, concerns about encouraging more physical activity in buildings for good health and to fight childhood obesity are certainly valid. Similarly, safety in schools has been an ongoing public concern suggesting more attention be given to entrances and exits from the building. In this context, the process of moving, wayfinding, and controlling access in a public school building is part of the overall equation, driving strategies for successful designs.

Controlling Entrance and Interior Doors

The role of entrances and doors in contemporary schools buildings is a bit paradoxical. On the one hand, they need to be open and inviting for students, parents, and community members. On the other hand, they need to be restrictive and controllable to address safety and security concerns. Add to that the need to function seamlessly while standing up to the high traffic and abuse of any educational environment and it is easy to see why doors consume a fair amount of design time.

A big part of the solution to the functionality of doors lies in how they are operated which usually means selecting the appropriate control hardware. Since most school entrance and corridor doors need to meet code egress requirements, heavy-duty, durable, exit devices are often required. Some have smoother,

Photo courtesy of DORMA



Doors in schools can be designed and configured to foster appropriate movement of students while maintaining control for safety.

reduced projection touchbar assemblies which are more aesthetic and minimize catch hazards. Similarly, heavy-duty door closers can be applied to these doors that use a hydraulic control system to allow for a full range of spring power adjustment and backcheck that can be specified to meet different conditions. Whenever controlled release and closing of doors is necessary for safety or convenience, door holders composed of a door-mounted catch plate and a floor- or wall-mounted electromagnet are appropriate to use in conjunction with door closers. Products are available with built-in protection and low residual magnetism so they release easily, even in applications meeting ADA requirements, with minimal spring force door closers.

Of course, doors need to be locked and secured at different times and in different locations. Many schools are incorporating an electrified system that includes a central console for remote control and monitoring of doors around the school building. This requires electrical power coordination to those doors but modular systems are commonly available to meet the specific needs of virtually any electric lock system. A well-organized installation for individual or multi-door systems may include locking devices, access controls, and station controls all coupled with consoles for remote control, annunciation, and interface with fire and life safety systems.

Sliding Doors

Not all doors need to be swinging nor do they all need to be limited to a single leaf. The use of sliding doors in single or multiple panels not only allow access, they can also create appropriately sized, transformative study spaces. When closed, sliding multiple door panels produce privacy on demand with the option of an embedded swinging door to maintain access. When opened by students or teachers, larger team study spaces can be easily created.

Photo courtesy of Space Plus, a division of The Sliding Door Company



Multi-panel sliding doors can enclose a small study room or open up to create a larger collaborative space.

Such sliding doors are typically made out of aluminum frames with a very high recycled content adding to their green and sustainable attributes. Since aluminum also typically requires no on-site finishing, there is no contribution of harmful vapors to the indoor air. Inside the aluminum frames, glass panels can provide the additional advantage of natural or borrowed light. This means that the space being enclosed does not need to be dark simply because the doors are shut. If privacy is needed, then it is entirely possible to use glass that is translucent, tinted, or otherwise treated to achieve the desired effect.

A significant advancement related to the way students move about a building, is their increasing use of tablets, laptops, or smartphones for taking notes or learning electronically. In other words, students are moving around the school with a "bring your own devices" (BYOD) mindset. Allowing for wireless connections to access the appropriate educational information creates great freedom and flexibility in their use and the opportunities for learning. It also means that movable portions of walls and sliding doors don't need to provide wired connections, but they do need to allow appropriate separation of space when students need to work in collaborative environments on group assignments on their own devices. Sliding door solutions are being used to accommodate this trend in many small and large group study rooms as well as larger, open, collaborative work areas.

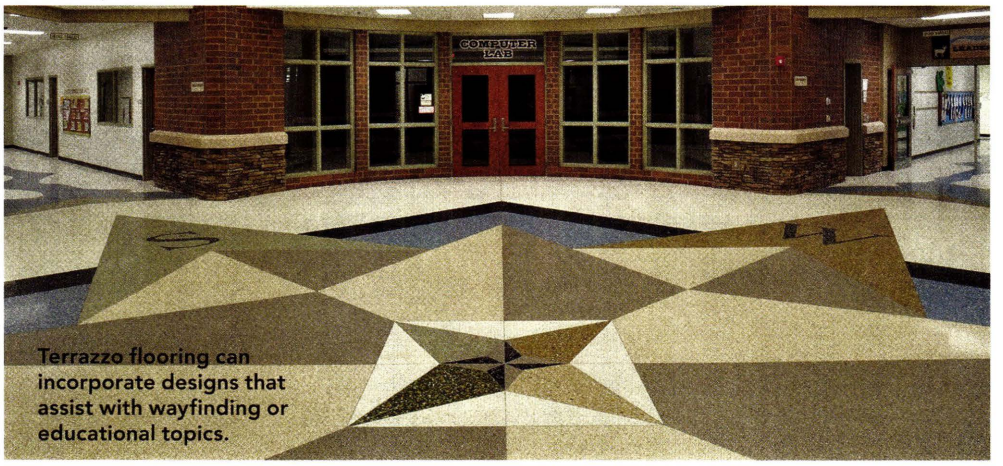
Making High-Traffic Areas Durable

School common areas such as corridors are, by nature, high foot traffic areas used virtually every day that school is in session. That means they need to be easily cleaned daily and the flooring material needs to be durable enough to handle all the traffic, cleaning, and other demands over the life of the building. One durable and sustainable choice for such flooring, stairs, and even corridor walls, is terrazzo, which is a traditional material that has been modernized to meet current needs. Terrazzo is a composite system consisting of either a cement or resinous matrix with an aggregate of marble, granite, onyx, or glass (in resinous systems). It is poured-in-place, cured, and ground to a smooth hard surface finish. Terrazzo is non-porous and does not support microbial growth, nor does it allow moisture to accumulate, contributing to a mold-free, healthy environment. Additionally, terrazzo is comprised of zero-VOC materials, and exhibits little to no off-gassing over the life of the cured material. As a very low-maintenance system, terrazzo can be cleaned with an environmentally friendly, neutral-pH cleaner which will not irritate sensitive eyes or noses.

The custom nature of terrazzo installations means that designs of all types and colors can be incorporated into the flooring. For example, wayfinding information can become part of the floor to help students become oriented and find other areas of the school building. Alternatively, maps, historical events, scientific facts, numbers, poems, or other educational information can be displayed in the floor for educational and space-making purposes. And in the interest of fostering school spirit, athletic mascots and school seals can also be included in prominent locations.

In regard to durability, terrazzo has been documented numerous times to withstand not only normal wear and tear, but dramatic events such as floods and hurricanes. The Central Intermediate School in Ottawa, Illinois, was inundated by flooding in 2008 and the only sections found perfectly intact were the terrazzo corridor floors. When the decision was made to rebuild the school in a new location, terrazzo was selected not only for the corridors, but also for the cafetorium and restrooms as well. "That the school district installed terrazzo again in the new building is a testament to their recognition of its longevity and durability," said George Reigle, project architect with Green/Associates of Deerfield, Illinois.

Photo courtesy of National Terrazzo & Mosaic Association



Terrazzo flooring can incorporate designs that assist with wayfinding or educational topics.



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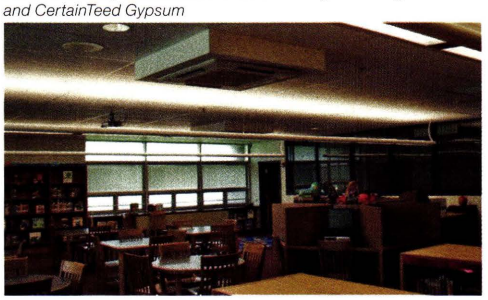
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By looking at all aspects of acoustics in a classroom, including quieter HVAC systems, students can hear better, teachers can talk in normal voice tones, and learning is enhanced.

Photo courtesy of Guardian Industries Corp.



Modern glass technology allows abundant daylighting, views, and controllable impacts on energy performance in school buildings.

3. HOW STUDENTS HEAR

With educational space planning and movement concerns addressed, we turn our attention to some specific sensory needs of students. In regards to the sense of hearing, the Center for Green Schools/McGraw Hill study of 2012 points out that ample evidence exists showing classrooms can have a negative impact on students' ability to hear, thus clearly making it difficult for them to absorb and retain information. Hence acoustical control of school spaces has appropriately become an important design issue.

A basic acoustical control concern in schools is background noise that can originate from within or outside of the building. Obviously, separating classrooms acoustically whether using fixed or movable walls and doors is a first place to start and has become a part of green building rating systems for schools. For fixed walls or floor/ceiling assemblies, one available strategy is to use noise-reducing gypsum board that is specifically designed to reduce airborne sound transmission between two adjoining spaces.

Other acoustical control measures are important as well. For example, noise from outdoors can penetrate exterior walls and windows, making it more difficult for students to hear and for teachers to speak without raising their voices. Addressing the acoustic qualities of exterior walls in the same manner as interior ones will help in this regard. When it comes to windows, a common strategy is to use laminated glass in one or more of the layers of an insulated glass assembly. The laminated glass has been shown to create noise reduction benefits as well as enhancing security in schools.

Within the classroom, background noise can sometimes be generated by mechanical heating or cooling equipment. Selecting such equipment or systems with attention given to the amount of sound generated within the space will be important. Ductless or split systems are available that can deliver comfort without compromising acoustics by operating at decibel levels quieter than a whisper.

4. HOW STUDENTS SEE

Historically, daylight was used as the predominant source of light for students to see inside school buildings. The energy crisis of the 1970s, however, gave rise to school buildings with few or even no sources of natural light in an effort to reduce heating or cooling energy. Experience has since shown that natural daylight combined with appropriate electrical lighting provides both the right quantity and proper quality of light to enhance learning and academic performance. Further, the positive impacts of natural daylight on student health and performance have been studied and documented in numerous studies showing improvements ranging from slight to significant. One well-known study showed that 8,000 students in grades three through six who learned in fully daylit classrooms demonstrated significantly greater improvement over the course of a school year in standardized test scores than students who were learning in non-daylit classrooms (Heschong Mahone Group, 2003, as cited in "The Benefits of Glass" prepared by the University of Michigan Taubman College of Architecture and Urban Planning in partnership with Guardian Industries Corp.). In a separate study, the California Energy Commission reported learning rates improved 21 percent for 21,000 California elementary school students in classrooms with the most daylight compared to those in classrooms with the least daylight. (October 2003, by New Buildings Institute based on research by Heschong Mahone Group.)

Better Glass and Glazing

Over the past several decades, glass manufacturers have developed ways to address daylight and energy performance. Rosie Hunter of Guardian Industries Corp. observed, "Today, many different glass products exist to help architects create better learning environments. The days of a row of small windows in classrooms have ended as architects have taken advantage of advancements in glass technology to increase the use of glass in school designs while still addressing energy performance." By using glass products with varying degrees of visible light transmission and solar heat gain coefficients, architects can use the sun's energy to create a passive heat source in cold climates or to limit solar heat penetration in warmer climates. Hence, energy use and glare can be addressed and balanced to create a positive light quality for students to see and work in.

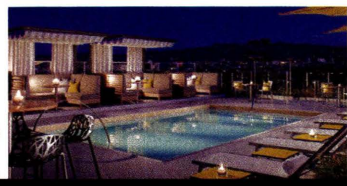
In addition to daylight, the other beneficial aspect of windows is to facilitate students seeing longer distance views outside of the classroom. Doctors have known that eyestrain and visual acuity problems can develop if students have only short distance views available to them. It is suggested that in order to keep eyes healthy, long distance views are needed. The color of the glass certainly comes into play in this case and many clear, neutral blue, green, and gray colors are available that can enhance specific views, control glare, and generally create desirable visual conditions.

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THE HOTEL WILSHIRE, LOS ANGELES





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When real estate developers Michael Orwitz, Spence Mitchum and Justin Khorvash went looking for a location to create their Four Diamond boutique hotel, The Hotel Wilshire, even they couldn't have imagined the hidden gem they would find in this dilapidated six-story medical building. But, after assembling some of the best professionals in the hospitality business, it was clear that their endeavor was about to become a reality.

After finding a design team that shared their views on the importance of sustainability, they set their sights on making The Hotel Wilshire LEED Silver Certified. Which meant air quality, as well as occupant comfort, would be important factors.

Enter Mitsubishi Electric's VRF zoning systems. Mitchum had experience using the VRF zoning system with a previous boutique hotel. He knew the system's flexibility, performance and efficiency would play an important role in obtaining LEED certification for this 74-room boutique hotel.

The Mitsubishi Electric VRF zoning system proved to be a perfect fit. Twelve months after its opening, The Hotel Wilshire boasted a LEED Silver certification, 17 percent less energy use, and one of the best views in L.A. from its chic rooftop pool. Just the type of epic performance you'd expect from a star in the hospitality industry.

PROJECT SUMMARY

Dilapidated six-story building remodel:

- 55 Guest Rooms
- 19 Suites
- 1 Rooftop Penthouse Suite
- 1 Rooftop Pool Deck w/ 500 Sq Ft Patio

Equipment Installed:

- 4 PLFY Ceiling-recessed Indoor Units
- 47 PMFY Ceiling-recessed Cassette Indoor Units
- 39 PEFY Ceiling-concealed Indoor Units
- 7 PURY R2-Series Outdoor Units
- 7 Branch Circuit (BC) Controllers
- 90 PAC Simple MA Remote Controllers
- 2 AG-150A Centralized Controllers

Results:

- LEED Silver Certification. 17 percent less energy consumption. 19 percent cost savings. Four Diamond Ranking by AAA.



Get more details about The Hotel Wilshire and see how Mitsubishi Electric solved other HVAC design challenges at **MitsubishiPro.com.**

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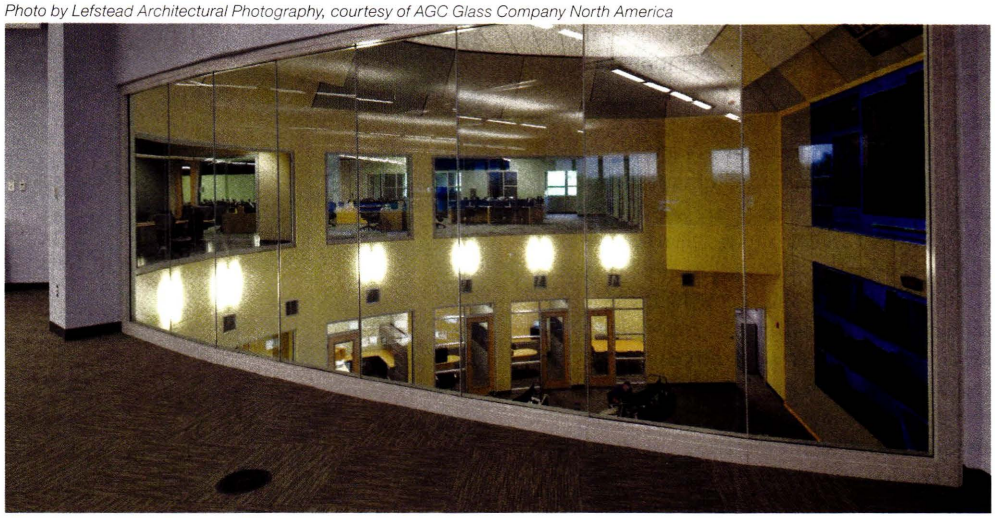
MADE IN AMERICA

CIRCLE 83

Glass use is not limited to exterior walls, however. Using glass in interior walls is often desirable to allow light and views to be shared from one space to another. In schools, this is problematic when the walls are fire rated. The solution is found in glass that is also specifically formulated to be fire rated and safe. The Safety Glazing Certification Council (SGCC) rates such glass which commonly uses a plastic interlayer laminated between glass outer layers. This combination helps the laminated layers hold together if a glass outer layer is shattered.

There are further distinctions in the types of fire-rated glass available. Fire-protective glass may be laminated (or use other means) to meet SGCC ratings for safety and fire protection, but it is not a barrier to heat transmission. Fire-resistive glass has an intumescent interlayer which expands at about 250°F to form a rigid and opaque barrier, blocking heat transmission from both convection and radiation. Complete, coordinated glazing systems are available that combine fire-resistive glass with pronounced or minimal frames. There are even butt-glazed solutions that eliminate vertical mullions completely and still provide the needed fire protection. Todd Danciak of AGC Glass Company North America pointed out, "As our society has changed, modern schools are being designed to provide a safer and more secure environment for our children, in addition to a place of learning and enrichment. The proper selection of glass can assure the building occupants of a highly visible, safe, and secure space."

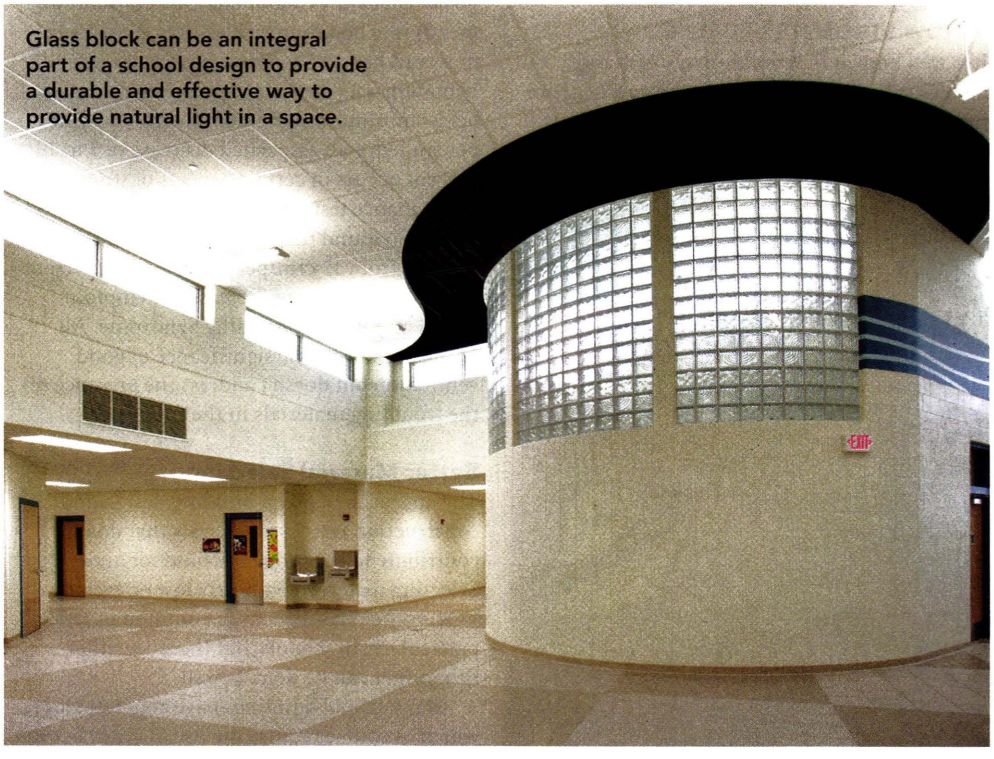
Photo by Lefstead Architectural Photography, courtesy of AGC Glass Company North America



Laminated safety glass, fire-protective glass, and fire-resistive glass all allow light and views to pass through from space to space while meeting a range of fire code and security requirements.

Glass is also commonly used in stairwells and exterior corridors raising security concerns in schools. Laminated glass and glazing provides a very workable solution since it is able to endure abuse due to interlayers of durable, clear films that keep the glass from breaking apart even when damaged. Further, it fits directly into standard window and glazing frames, making installation very straightforward. Altogether, laminated and fire-resistive glass offers the multiple benefits of code compliance and security enhancement while still allowing light and views to be incorporated into the overall design of school spaces.

Photo courtesy of Pittsburgh Corning



Glass block can be an integral part of a school design to provide a durable and effective way to provide natural light in a space.

Glass Block

In addition to glazed windows, the use of glass block in school buildings has been a recognized strategy to enhance lighting schemes in both exterior and interior walls. Glass block has long been used to help architects design schools that are both creative and sustainable. Among its attributes, glass block provides daylighting with the option of obscuring views or allowing them, which means privacy and transparency can be controlled as desired. Since glass block is thicker than glass, it offers strength against damage or vandalism with surfaces that are easy to clean of graffiti. The make-up of the glass block allows for higher degrees of sound reduction compared to traditional windows. And, similar to glass, fire-rated glass block can be used in fire-rated wall assemblies to allow light to be shared between spaces.

In Hudson, Wisconsin, the 93,450-square-foot River Crest Elementary School took advantage of glass block to enhance the design for 588 students in grades kindergarten through five. Commissioned in 2006, the school was to be a highly sustainable and innovative education center. Glass blocks enabled the designers to meet the prerequisite challenge of acoustics to ensure classrooms are quiet enough for learning while still providing natural light and helping to reduce energy costs. In the final design, glass block was used in three separate areas. First, patterned glass blocks introduce light passing through windows and the main foyer into the guidance office, creating a distinctive design. Second, a different pattern was used in the story area of the library to borrow light from an adjacent window. For symmetry, glass blocks were also used between the story area and the adjacent computer lab. Third, glass block with a ripple pattern was used in the cafeteria to frame the opening to a central platform. In all, glass block proved to be an effective and desirable

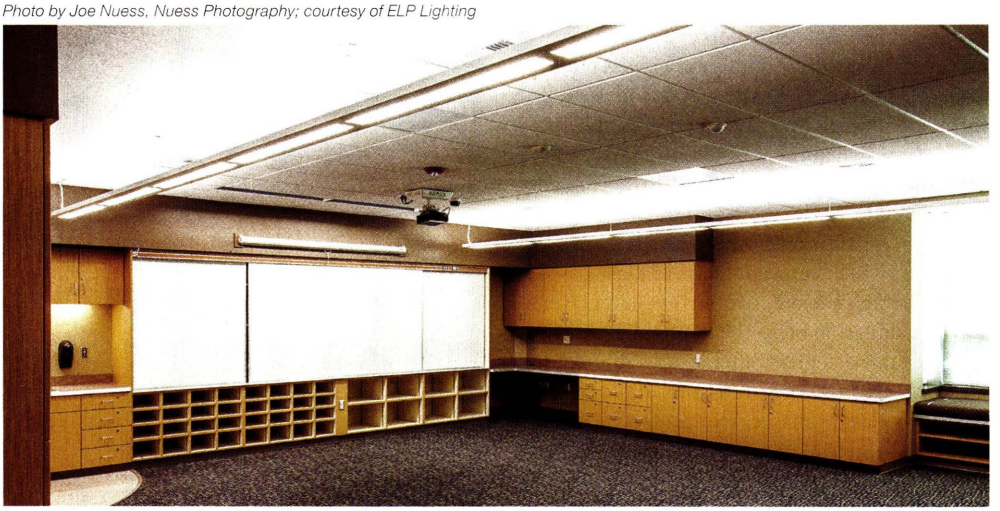
design strategy to allow light to transfer through spaces while meeting other operational needs.

Electric Lights

As noted earlier, the quality of light is essential just as the quantity of light is in creating better learning environments. Good light quality allows students to see clearly, have a feeling of warmth and comfort, and brings clarity into a space, thus allowing them to think clearly, inspiring their thoughts, ideas, and work. Electric lighting used in conjunction with daylighting, therefore, should be a positive reinforcement to the learning environment. The Illuminating Engineering Society (IES) reinforces this notion in *The Lighting Handbook 10th Edition*, Section 24.1 – Lighting for Education, where it states, "Knowledge acquisition and the process of learning involve the visual exploration of tangible forms and the discovery of concepts from written and graphical displays on paper, computer, and projection. Lighting's role is fundamental. However, lighting also sets the scene for listening, developing social skills, comprehending situations, and recognizing and understanding places."

In the context of modern classrooms and study spaces, quality lighting is needed not just for general ambient lighting, but also for specific needs related to white boards, wall displays, coves, exterior walkways, video conferencing, or distance learning applications. In order to meet varied needs, fixtures are available specifically for school designs that distribute light in asymmetric or other specific patterns in a variety of fixture shapes, sizes, and energy-efficient lamping options (i.e. LED and fluorescent). This variety means that they can be selected and specified to provide the particular lighting needed for specific situations. For example, in the case of Sunset View Elementary School in Kennewick, Washington, the classrooms are complex in their uses with the availability of many different media that can be used as teaching tools. The classrooms have a white board or smart board on the wall and above is a flat-screen monitor for video reception. While the white/smart boards need to be illuminated, light on the flat screen will wash out the image. Hence, adjustable wall wash fixtures were used to solve this problem by allowing adjustment of the light distribution so there is no light above the top of the white/smart board. Further, for the general area, suspended direct/indirect fixtures were used that provide very good dispersion of light and good light quality overall.

Photo by Joe Nuess, Nuess Photography; courtesy of ELP Lighting



Recessed wall wash fixtures illuminate the white boards while indirect/direct luminaires provide general illumination at Sunset View Elementary School in Kennewick, Washington, designed by MMED Architecture.

5. HOW STUDENTS BREATHE

It is well known that building systems and materials have the potential to create a negative impact on the overall air quality in a building. Enclosed classroom spaces where students and teachers spend most of their time can accumulate unwanted things in the air they breathe including particulate matter, volatile organic compounds (VOCs), and other toxic materials that can have a variety of negative health impacts including respiratory issues, visual disorders, and memory impairment. The most prominent VOC, formaldehyde (present in many composite wood products), as well as Phthalates and Bisphenol A (BPA) (both present in many plastics used in construction), are still being studied. Further, moisture intrusion in building materials can lead to problems with mold contributing to respiratory illness and asthma.

How should we best deal with creating positive, healthy indoor air? One conventional means is to add more ventilation. According to researchers at Lawrence Berkeley National Laboratories, when ventilation rates are at or below minimum standards (roughly 15 cfm per student), an associated decrease of 5 to 10 percent occurs in certain aspects of student performance tests (LBNL IAQ Resource Bank). They also found that when ventilation rates were lowered from 17 cfm/person to 10 cfm/person, they saw a 15 percent increase in symptom prevalence for Sick Building Syndrome. All of this reinforces the significance of good ventilation but doesn't address the presence of the troubling materials in the first place.

Photo courtesy of U.S. Concrete



Rapid-drying concrete can be specified to reduce the presence of retained moisture in floors that can help eliminate mold concerns in schools.

Better Material Selection

The approach of green building design and construction is to use materials that don't contribute to the problem of indoor air quality. Selecting materials with very low or even no VOC content has become a common practice, particularly in schools, but there are other things that can be done as well.

Many school buildings have concrete floors, which of course require the use of water in their

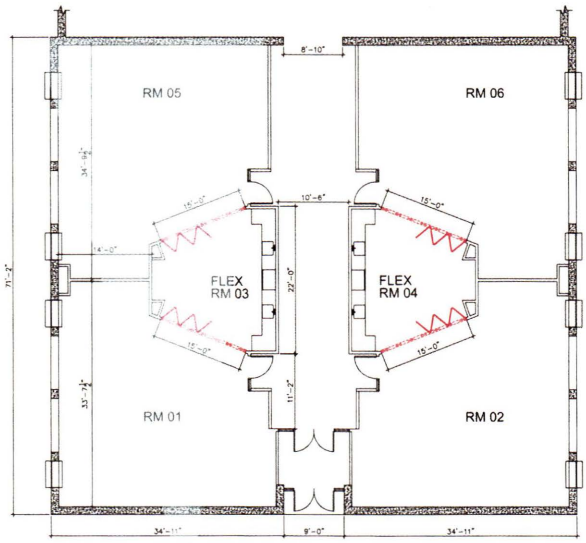


Burleson Elementary School, Burleson TX • NanaWall Aluminum Framed Folding System SL45 • Architect: SHW Group

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—Principal Sue Anne Sullivan



* Figure 1

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pouring and curing. If floor coverings are put down too soon, then some moisture may get trapped in the concrete and can eventually cause the deterioration and failure of the flooring, not to mention the creation of mold in the flooring material. In those cases, the floor covering needs to be removed and new flooring installed—a rather expensive and disruptive procedure that could have been avoided by specifying the most appropriate concrete mix for the school to begin with.

Photo courtesy of CertainTeed Gypsum



Specially formulated gypsum board can be used to absorb and eliminate specific VOCs from the air in classrooms. The VOCs are given off by furniture or other sources.

Fortunately, rapid-drying concrete is available for these situations in ready-mixed form that reduces the drying time and risks associated with excess moisture vapor in concrete slabs. This enables faster, more effective floor topping installations and, because of the reduced final moisture content, reduces the likelihood of mold formation. Peter Craig, a concrete floor specialist, observed, "Rapid-drying concrete dries naturally in as little as 30 days and because it consumes its free water internally, shrinkage and curling are significantly reduced." He considers its use a "no-brainer" for any project where trapped moisture is a concern or where size tolerances are important.

What about walls and ceilings when it comes to indoor air quality? Once again finding materials that have few if any problematic toxins or chemicals is the best place to start. But it is unlikely that they will be totally eliminated, particularly since they can be brought in from furnishings and equipment, raising the question of how to best address their presence. In response, a family of innovative gypsum board products has been developed that has been shown to help clean the air and improve indoor air quality. The specially formulated gypsum board permanently absorbs and removes specific VOCs and formaldehyde, the most prominent VOC, which may be circulating within indoor air. Using advanced technology, this class of gypsum board captures and converts formaldehyde into inert compounds, so that it cannot be re-emitted into the air. The effectiveness of the process has been tested in accordance with ISO 16000-23 and validated by UL Environment through their Environmental Claims Validation (ECV) program. It has been shown to continue to effectively clean the air even when used with multiple coats of water-based acrylic or epoxy paints and breathable wallpaper based on tests conducted by independent laboratories. It also contains materials that offer superior protection against moisture and mold. These gypsum board products can be installed and finished like regular gypsum board and are recyclable at the end of their useful life.

The Northern Lehigh School District in Pennsylvania remodeled an elementary school using gypsum board to improve indoor air quality and help control sound attenuation. Greg Deer, the director of support services for the school district, commented, "We've gotten very favorable results from the new classrooms—sound is contained, the spaces are very comfortable, indoor air quality has improved, and allergy complaints have dropped. The selected drywall was crucial to us achieving these results that have helped create a top-notch learning environment for our students."

Reducing the Spread of Germs

In addition to chemical concerns, school environments are notorious for contributing to the spread of germs and sickness. Given the concentration of children and the ease with which germs can spread, it is easy to see why students miss an average of 4.5 days of school per year while teachers tend to miss more at 5.3 days per year. Even if they are not out of school, when they are fighting off illness, they are often not functioning at their best.

Photo courtesy of KIMBERLY-CLARK PROFESSIONAL®



Paper towels in dispensers have been shown to spread less bacteria than air dryers, thus helping to reduce possible sickness among students and teachers.

Data shows one of the best ways to reduce the spreading of germs and absenteeism is by washing hands. However, a new European study has pointed out that drying hands is part of the equation too. Research on "Microbiological comparison of hand-drying methods: the potential for contamination of the environment, user, and bystander" carried out by expert medical microbiologists E.L. Best, P. Parnell, and M.H. Wilcox in England has been printed in the *Journal of Hospital Infection* (August 2014). It compared the spread of bacteria using three hand-drying methods: 1) jet-air style hand dryers, 2) warm air hand dryers, and 3) paper towels. In so doing, they documented that air dryers cause bacteria and water droplets to be blown into the air, onto users and bystanders, thus risking cross contamination between washroom users.

Continues at ce.architecturalrecord.com

Peter J. Arsenault, FAIA, NCARB, LEED AP, *has authored over 100 continuing education and technical publications as part of his national architecture and green building practice. www.linkedin.com/in/pjaarch*

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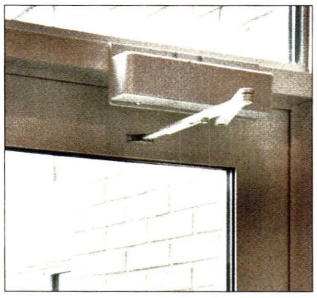
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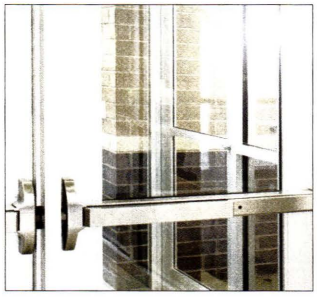
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[1] University of Westminster, Nov 2008 – a comparative study of different hand drying methods

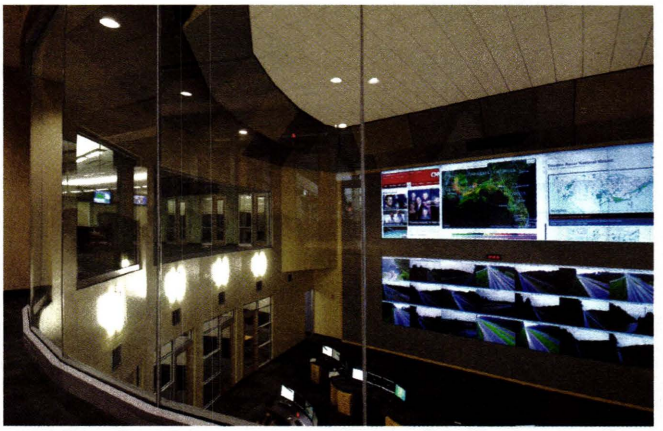
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CIRCLE 88

PRODUCT REVIEW

School Buildings in 2015: Designing for Students

AGC Glass Company North America



Transparent Glass Wall System

Available exclusively from AGC, the Vision 60 and 120 Systems combine the superior performance of the Pyrobel® fire-resistive glazing and the clean profile of either Quick-Frame™ or StileLite™ framing at the perimeter to create a continuous butt-glazed transparent glass wall—with no unsightly vertical mullions. The new Vision 120 System is certified for 2-hour fire rating.

www.pyrosafeglass.com *Circle 101*

Bison Innovative Products

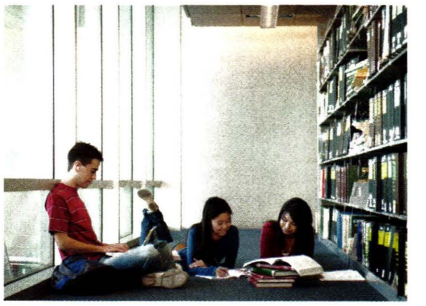


Rooftop Environments

Create beautiful rooftop environments with modular decking systems by Bison Innovative Products. Bison adjustable screwjack pedestals support a variety of surface materials such as Bison Ipe Wood Tiles, concrete pavers, stone tiles, and decks on joists. Customize the spaces even further with Bison Cubes—handcrafted planters and modular benches.

www.BisonIP.com *Circle 102*

CertainTeed Gypsum

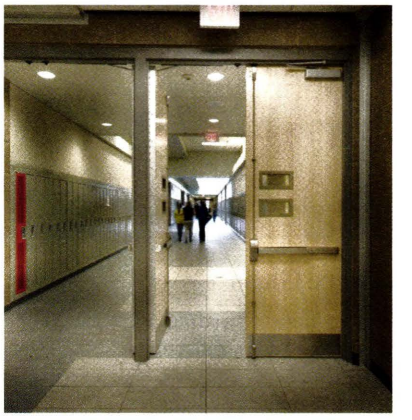


Indoor Air Quality Gypsum Board is First in its Class

CertainTeed AirRenew helps sustainability in schools by activity improving indoor air quality. It cleans the air by permanently removing formaldehyde circulating indoors and converts it into safe, inert compounds. This gypsum board also has superior M2Tech® technology, providing enhanced moisture and mold resistance per ASTM G21 and ASTM D3273.

www.certainteed.com/airrenew *Circle 103*

DORMA

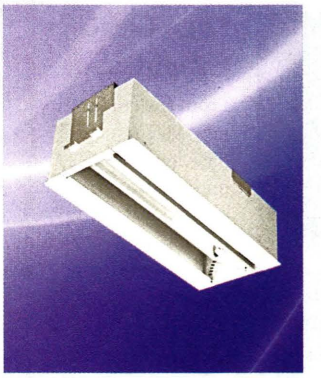


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ELP Lighting



Recessed Adjustable Wall Washers

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www.elplighting.com *Circle 105*

PRODUCT REVIEW

School Buildings in 2015: Designing for Students

Endicott Clay Products

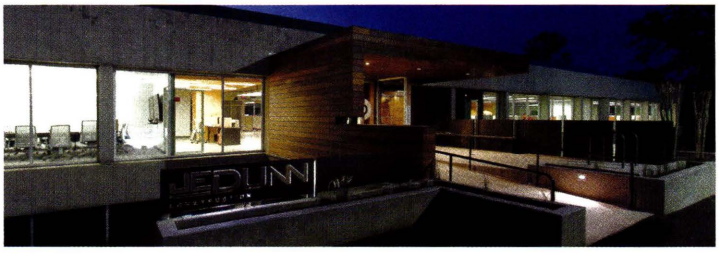


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Logo Bleacher Graphics

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The MOD* Stainless Steel Dispensing System Recessed Wall Unit with Trash Receptacle, provides a complete solution for high-capacity towels and touchless technology. With bacteria-reducing benefits of drying with paper towels and paper towels made from rapidly renewable fibers, the MOD* Stainless Steel Recessed Unit with Trash Receptacle supports and promotes better hand and surface hygiene.

www.kcprofessional.com *Circle 109*

Mitsubishi Electric Cooling & Heating



Highly Efficient, Customizable Building Comfort Solutions

Mitsubishi Electric Cooling & Heating is a leading marketer of variable refrigerant flow (VRF) zoning systems. Its VRF zoning systems increase energy efficiency, improve comfort for students and teachers, and minimize noise disruption to help create better learning environments in all types of educational buildings.

www.MitsubishiPro.com *Circle 110*

project: Hillshire Brands, Chicago IL
architect: Perkins + Will
landscape architect: Wolff Landscape Architecture, Inc

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PRODUCT REVIEW

School Buildings in 2015: Designing for Students

NanaWall Systems



Architect: Hollis + Miller Architects

Flexible Space for Schools

NanaWall FlexSpace eliminates the traditional fixed-wall classroom by creating shared space between two classrooms or by opening up to a common area that is shared by multiple classrooms or grades. Teachers can share resources and cross-collaborate, creating a more efficiently run school environment.

www.NanaWall.com Circle 111

National Terrazzo & Mosaic Association, Inc.



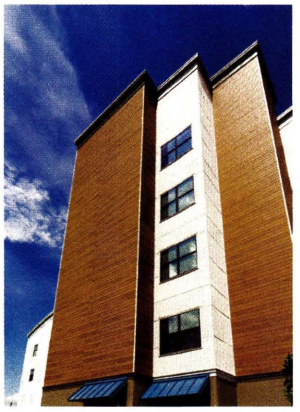
Photo by David Laudadio

Terrazzo Makes the Grade

Whether you seek to complement or contrast a specific building design, depict a school logo, or inject a splash of vibrant color, terrazzo can earn your next school project high marks across the board. Terrazzo's anti-microbial, durable, sustainable, and easy-to-maintain surface makes it the premium choice in flooring.

www.ntma.com Circle 112

Nichiha USA, Inc.

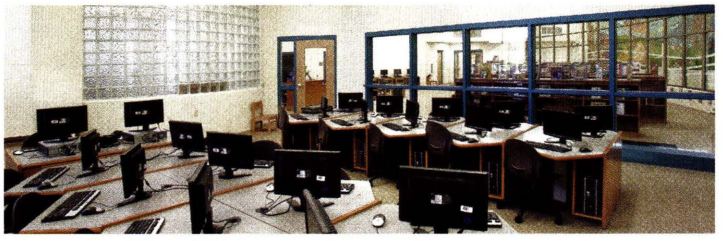


Architectural Wall Panels

When your project calls for something more than the ordinary, consider VintageWood. Its warm colors can be interpreted as modern or vintage. This versatile product installs vertically or horizontally, giving you design flexibility. Nichiha systems provide hidden fasteners for a clean and beautiful look along with a meticulously engineered drained and back-ventilated rainscreen that effectively manages air flow and moisture.

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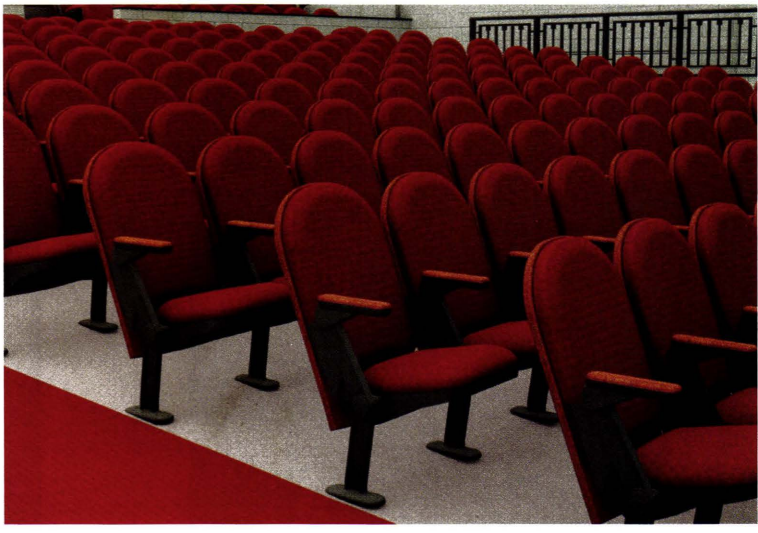
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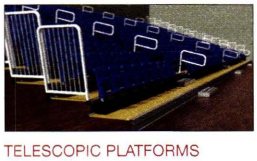


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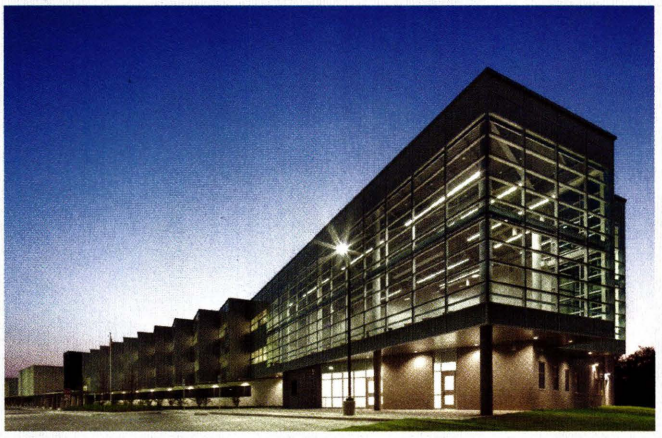
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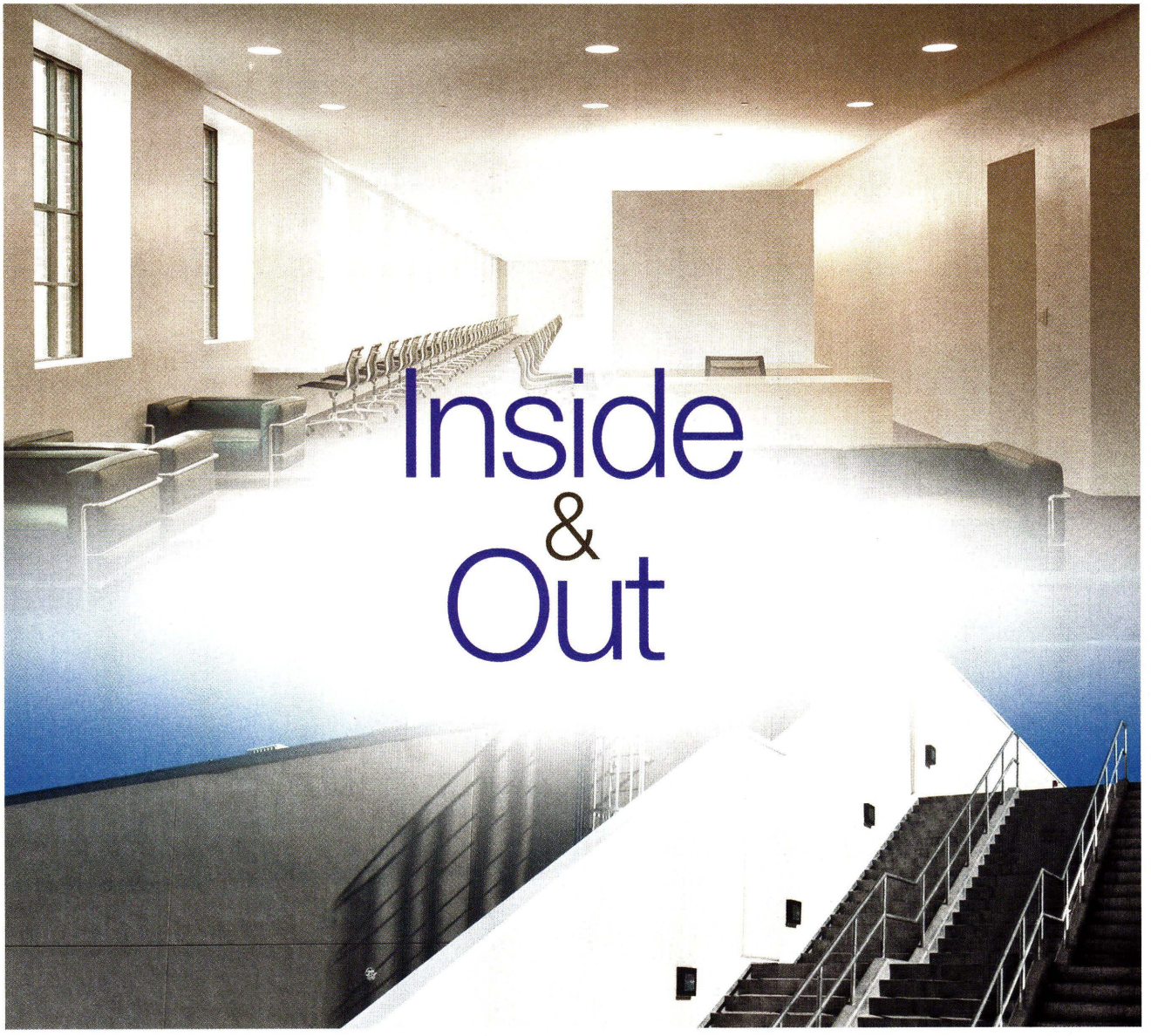
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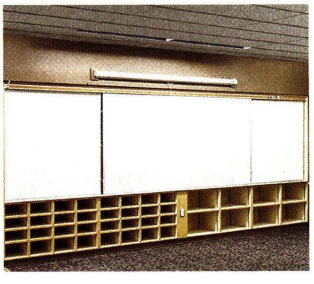
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Architecture firm Antunovich Associates reimagined the faded casino hotel, the 23-story former Golden Phoenix in Reno, Nevada, as a mixed-use residential community with floor-to-ceiling windows with unplasticized polyvinyl chloride (uPVC) tilt-turn frames.

Fenestration Solutions for Efficiency and Performance

New windows and doors improve building energy efficiency and occupant comfort

Sponsored by Dow Corning, Menck Windows, REHAU North America, and Wasco Skylights | *By C.C. Sullivan*

Global trends in architectural design these days seem focused on getting more transparency per square foot, throwing many of the reasons not to fenestrate out the proverbial window. This is after a few years of pulling back the reins on transparency, due to such varied concerns as energy costs, facility security, sound transmission, and glare from the sun. Yet the window-to-wall ratio, or WWR, is no longer a solitary fixation for architects and their clients. More attention today is given to enclosure U-value (also given as U-factor), the overall heat-transfer coefficient measured in BTUs per square foot of a given building assembly per degree temperature difference.

Part of the swing toward more open envelopes is end-user demand. For example, in a recent article on apartment building design by editor Penelope Green in *The New York Times*, a real estate broker says, "Now what most people wanted in their living rooms, they want in their bathrooms. They'll say, 'What? No view?'" Apparently it's just as fun to be seen as it is to see out, whether the spaces are sacred or profane. Newly renovated historic landmarks such as Walker Tower by the firm CetraRuddy exemplify the trend, reports Green, alongside

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Learning Objectives

After reading this article, you should be able to:

1. Explain the multiple, interrelated ways in which fenestration products affect building performance and energy efficiency.
2. Discuss current energy codes and how fenestration variables relate to specific prescriptive and performance-based design criteria.
3. Describe specific fenestration solutions and how they can be used to improve building performance, including aerogel glazing and tilt-turn window systems.
4. List related building performance objectives considered for energy-efficient fenestration systems that address occupant comfort and need.

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Photo courtesy of Wasco Skylights



Aerogel-filled skylights bring the sun into the nation's first LEED Platinum grocery store while keeping R-values high. Architect Next Phase Studios designed the grocery, located in Augusta, Maine.

innovative new high-rises such as 215 Chrystie Street by Herzog & De Meuron, a concrete-and-glass composition with interiors by architect John Pawson.

All this exhibitionism might come at a real cost if it weren't for a raft of new fenestration products that improve the feasibility of expanding glazed areas, whether on the roof or even on south-facing facades like Walker Tower's primary exposure. "As compared to a new roof with its R-value of about 30, a conventional skylight or window comes with an insulating value of R-1 or less," says Mike Reeves, an executive with Wasco Skylights. "Yet, new glazing technologies such as electronically tintable glass and polycarbonate panels filled with aerogels help improve privacy, diffuse sunlight, and reduce infrared, yielding values of about R-6," he adds. Many architects look for windows and skylights boasting a target value close to R-5 or better, which improves upon typical products bearing the U.S. Department of Energy's ENERGY STAR label.

In fact, today's building projects get a boost from window and door products like the aerogel skylights that have emerged on the scene very recently. Just as many others, however, rely on ideas that have been around for many decades. An example is the tilt-and-turn window, a hallmark of European modern architecture and a growing specification for various building types in the United States. Tilt-turns offer three separate functions in one window: a traditional casement look in the turn position, convenient top ventilation in the tilt position, and ideally a well-sealed, efficient picture window when closed. The newest versions, however, feature bulked-up profiles and thicker glazing.

New or old, these advances share a few important traits: First, they help architects meet and exceed today's challenging energy rules, including the International Energy Conservation Code (IECC) and jurisdictional "reach codes" in states from California to Massachusetts. Second, they enhance daylighting and views without unwanted interior temperature swings. Third, they add a range of performance features from improved interior acoustics and physical security to improved enclosure interfaces and enhanced durability.

"The tilt-and-turn systems stand to gain ground in today's environment of stricter energy codes, where building occupants expect comfortable interiors without the unchecked temperature swings caused by poor fenestration," says Alan B. Wall, director of sales and marketing with Menck Windows, which recently dedicated a new manufacturing facility on the East Coast. "The German-style tilt-turn systems have robust, thick sashes and frames, which work well with high-performance gas-filled lights and even triple glazing."

In addition to high-performance envelope projects in both the residential and commercial segments, Wall points to a few recent multifamily and institutional projects that have used these advantages to meet such voluntary standards as net-zero energy and Passive House (phius.org), which may specify quantifiable levels of both energy efficiency and occupant comfort.

With these gains in fenestration technology and performance are ideally placed to match the higher expectations of both building users and standard-setting bodies, it would seem sensible to invest time and design talent on their use. Yet even to employ today's best normative design strategies, many architects have to battle the client group's often steadfast focus on first cost, speed to market, and initial financial gain.

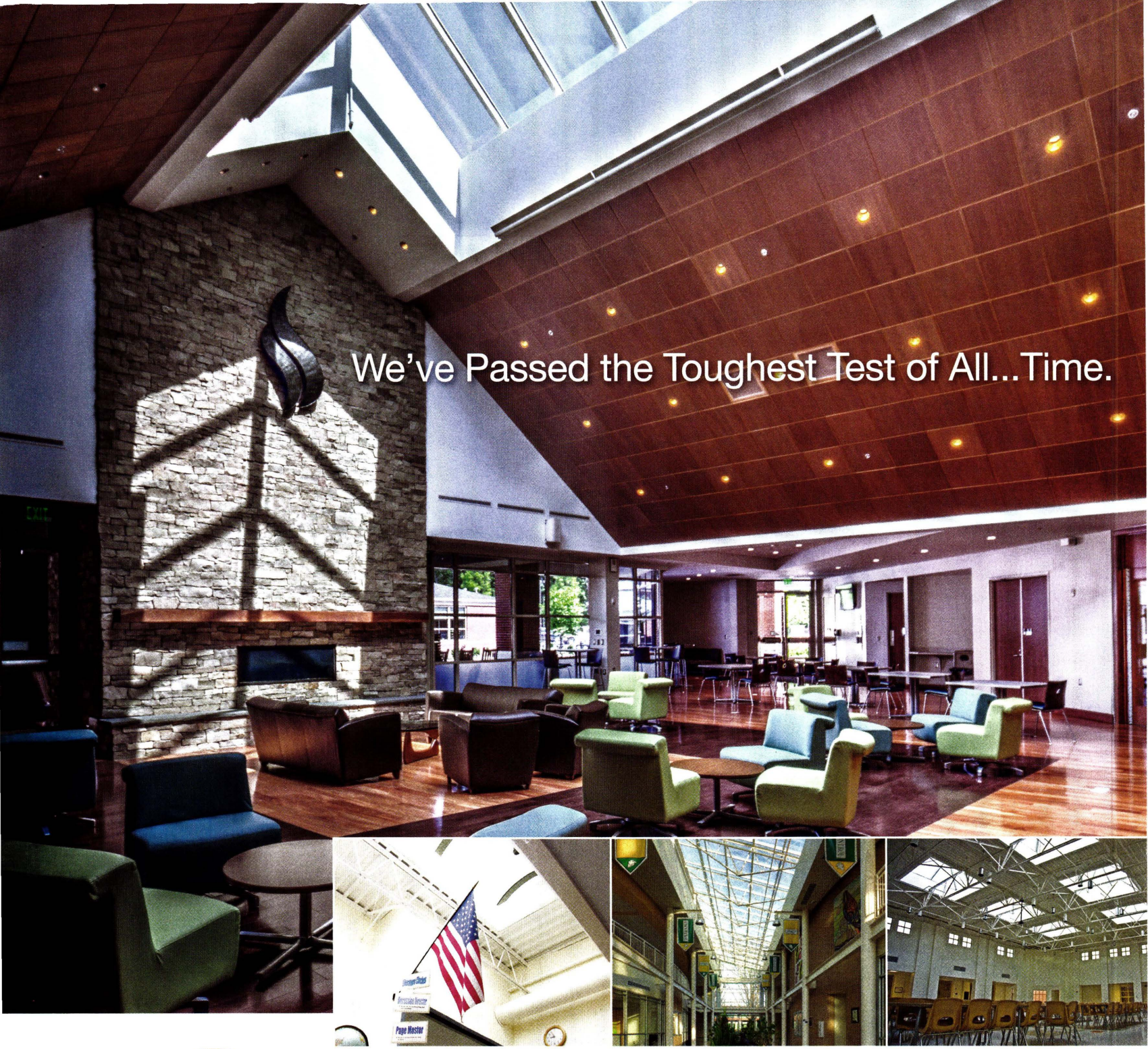
Architects are polishing up their skills to design better enclosures and to better convey the benefits to their clients and project teams, says Peter St. Thomas, a sales executive with 25 years of plant management and international technical expertise at REHAU North America. "There has been quite a movement on the value

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Elbchaussee, Germany

front in the building industry, so architects are grappling with how to find the windows that have the proper U-value," he says.

ENERGY CODES GUIDE FENESTRATION

"Some architects struggle to understand how fenestration performance numbers work in terms of design," adds REHAU's St. Thomas. "Many don't know how to specify new, performance-grade windows for the kind of building on the boards. Too often, they fall back on copy-and-paste specs, which may not serve their designs adequately." He and other fenestration technical experts recommend developing a "blended specification" that identifies key performance criteria for structural performance and energy transfer, ideally with a target maximum U-value. He also sees leading architects calling out the sound-transmission class, or STC, often to help make their buildings healthier for occupants.

Projects such as schools and hospitals may have significant issues in terms of energy performance and sound transmission, says Ralph Walker, RA, LEED AP, CSI CDT, an associate with architecture and interiors firm SmithMaran. "We work with the manufacturer to develop a customized specification on acoustics, which is based on an OITC rating, or outside-inside transmission class, the most applicable designation for how much noise comes into a space through an assembly," he says. Other key elements of the specification include thermal performance, shading coefficient requirements, and heat gain through the glass, Walker adds, as well as one final consideration: security.

Yet project designers like Walker often start the project focusing on energy performance first, because even small modifications to the glass or frame design can have an outsize impact on energy use over many years of building operations.

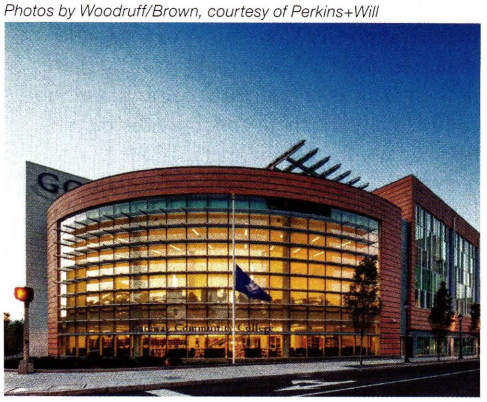
The key is to begin with products that help the overall assemblies meet or exceed the IECC, to ensure that energy performance is in line with regulatory and client expectations. This task has been eased for residences, as the energy conservation rules for IECC and the International Residential Code (IRC) are now aligned, as of their 2012 editions. On the commercial side, there's no more distinction between nonmetal- and metal-framed fenestration in the prescriptive provisions. But for many designers of large-scale open spaces for the public, there are recent mandates for daylighting coupled with automated shading and dimming control systems.

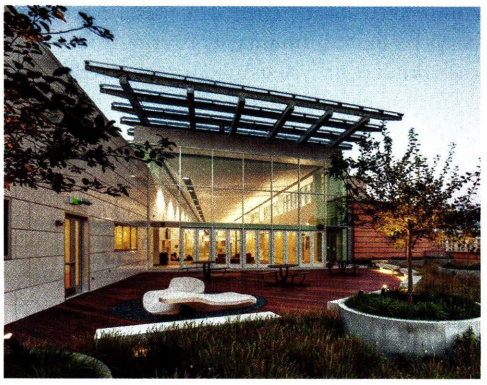
Starting with the basics, the 2012 IECC offers three ways to comply with the codes for residential projects and two paths for commercial construction. The prescriptive paths lay out minimum energy criteria for each product or system used for the building enclosure. For residential windows and doors, these prescriptive paths have no limitations on how much vertical glazing or how many skylights can be used on a house or apartment. However the prescriptive options are quite miserly on the commercial side: They may only be used if the total areas for glazing, windows, and skylights do not exceed the given limits. For the 2012 IECC, which is being adopted in many jurisdictions, automatic daylighting (dimming) controls are assumed for some of the more generous limits.

For example, according to Julie Ruth, P.E., a code consultant for the American Architectural Manufacturers Association (AAMA),[1] a building design can always have fenestration for up to 30 percent of its wall area. But this is relaxed to 40 percent of the above-grade wall area if daylighting controls are employed and the following two conditions are also met: At least half of the conditioned floor area receives daylighting and the glazing is specified with a ratio of visible transmittance (VT) to solar heat-gain coefficient (SHGC) that is higher than 1.1, Ruth explains. Like the three legs of a stool, however, for the higher WWR allowance to stand, all of these three design requirements must be met. A similar rule applies for skylights, allowing up to 5 percent of the roof area, an improvement on the 3 percent otherwise offered.

Changes like this one bring the IECC's prescriptive paths up to speed with leading architects and green building specialists who have advocated for the use of integrated dimming and daylighting for many years. "Why shouldn't we take advantage of the cost- and carbon-neutral resources available to us like sunlight, particularly if it can improve our health and well-being?" asks Breeze Glazer, LEED AP BD+C, a senior associate, sustainable design leader, and research knowledge manager with Perkins+Will. "One of the most effective means is to reduce daytime lighting loads by combining dimmable lighting systems with

Photos by Woodruff/Brown, courtesy of Perkins+Will





Recognized in the new IECC, integrated daylighting and dimming improves the efficiency of high-visibility façades as on the 367,000-square-foot, LEED Gold campus center for Gateway Community College in New Haven, Connecticut, designed by Perkins+Will.

properly orientated fenestration that provides for sensible, effective natural daylighting."

Another rule introduced in the 2012 IECC is a minimum requirement for skylight area that calls for toplighting 50 percent or more of any floor areas larger than 10,000 square feet in area, directly below the roof and with floor-to-ceiling heights of 15 feet plus. A long list of uses for the spaces makes them applicable to this minimum skylighting requirement, including convention centers and office spaces, manufacturing and warehouse facilities, retail and transportation areas, as well as any lobbies, atriums, corridors, concourses, or even storage areas.

THERMAL AND STRUCTURAL SPECS

With today's variety of glazing options, architects are specifying windows and curtain walls with a range of high-performance coatings, fills, and unit designs. "We see more projects employing specialized glass coatings, films, gas-filled and triple-glazed units," says Menck's Wall. "Thermal bridging is carefully considered in the construction of the window assemblies, such as extruded aluminum clad on wood windows where thermal bridging can be mitigated by not adhering the cladding to the face of the window but instead suspending the aluminum to minimize thermal movement."

For many owners seeking to improve thermal performance for existing building stock, it may not be feasible to renovate the entire envelope system. Some retrofit methods, such as adding new shading, glazing treatments, or films, may not be worth the expense and effort in certain cases, says William R. Brody, vice president with construction management firm B.R. Fries & Associates. "Instead, we see a large number of window replacement projects where the primary goal for the institutional or commercial owner is energy efficiency," he says, pointing to recent examples by major universities and hospitals. "An energy analysis will show that fenestration is the leading source of heat loss, though it may be a close second to the roof in some cases."

The energy-saving techniques built into replacement fenestration also benefit project teams facing aggressive state codes such as Title 24, which are "all about reducing solar heat gain by using better glazing materials," says Wasco's Reeves. "Both Title 24 and IECC look to the National Fenestration Rating Council, or NFRC, as the guideline, and they favor total system energy efficiency that includes the framing and glazing, not merely the center-of-glazing efficiency," he adds. For curtain wall and structural skylights, the framing is often aluminum, which is highly conductive, he adds.

Even though the skylight may be 98 percent glass and only 2 percent metal, the aluminum or steel will significantly affect its thermal performance. New framing alternatives to aluminum or wood include inner vinyl frames, which provide thermal breaks, and fiberglass pultrusions, also known as pultruded fiberglass. (A number of frame materials, including hybrid compositions, are available for punched window openings.)

While vinyl is now an option for skylight frames and skylights, some of the products are not suited to larger openings such as for structural skylights, which need hefty aluminum or other metal framing to support their weight across larger desired roof spans. "As building designs require larger and larger fenestration systems, traditional materials such as exposed aluminum and steel are typical for commercial applications," says SmithMaran's Walker. "The key is to maintain structural integrity on the perimeter and at all corners and to provide a continuous thermal break, working with the manufacturers to identify any natural weak points in terms of structure or thermal bridging." As an example, for continuous openings such as clerestory or ribbon windows, the lintel can become the bridge for thermal movement and moisture migration.

The NFRC independently tests, certifies, and labels the fenestration products for U-factor, SHGC, and visible transmittance (VT), which are all mandated for minimum performance. Additional ratings can be added by testing for air leakage rates—typically between 0.1 and 0.3 cubic feet per minute per square foot (cfm/ft^2), where lower is better. (According to one manufacturer, the passing rate of 0.3 cfm/ft^2 can be an uncomfortably drafty assembly, even as it meets the minimum standard.) For condensation resistance—given as a number between 1 and 100 where higher indicates better ability to resist condensation—architects must consider the expected conditions of each project's regional climate zone and local microclimates such as urban and coastal sites. Other factors not tested by NFRC but rated by others and essential to many project specifications include:

- **Water infiltration.** How much water and pressure a window system can resist to keep the water from leaking through.
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- **Acoustical isolation.** Testing the amount of sound transmission through a window yields a rating for sound transmission class, or STC, where the higher the number, the better it is at blocking noise. (Other ratings such as OITC may be used.)
- **Security capacity.** These ratings measure the ability of a window to resist different types of forces, such as those caused by windborne projectiles, fire and heat, ballistics, and attempted forced entry.

See endnote in the online version of this article.

Continues at ce.architecturalrecord.com

***C.C. Sullivan** is a marketing communications consultant specializing in architecture and construction.*

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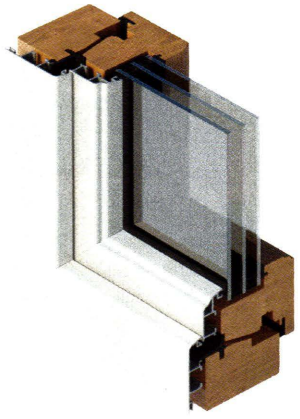


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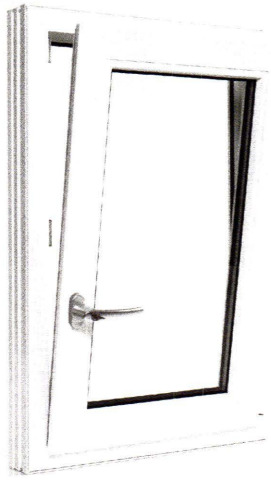


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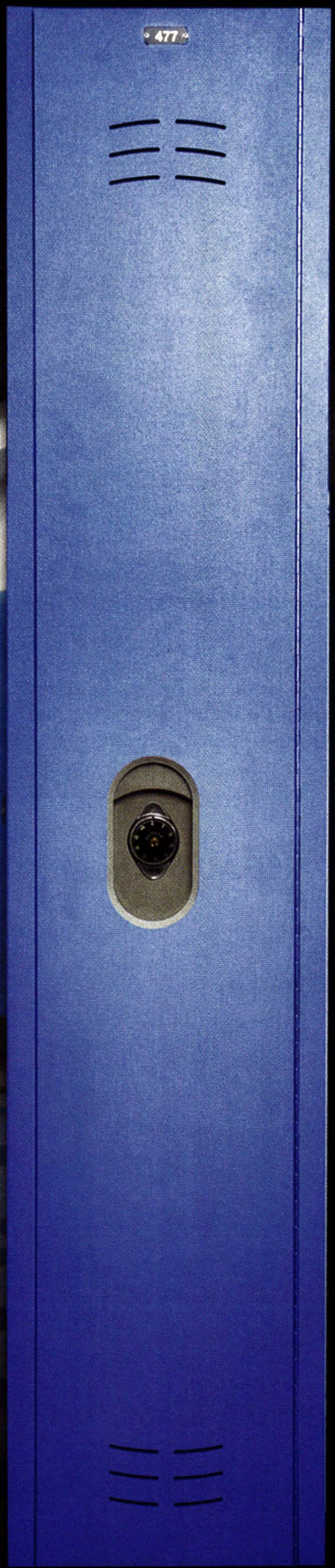
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Sponsored by Scranton Products | *By Jeanette Fitzgerald Pitts*

A school locker is the hub of a student's school life. As such, it is stuffed, slammed, and personalized multiple times a day, year after year, playing host to a veritable smorgasbord of school necessities and niceties: wet rain jackets, snow melting off winter boots, sweaty jerseys, leaking lunch sacks, science projects, textbooks, love doodles, and the like. Considering the regular use and abuse a locker receives throughout its life, it is no surprise that facilities personnel and designers routinely rank durability as the most important feature of this type of product. What may be surprising is that, until recently, the specification audience had few material options for school lockers outside of the traditional 16-gauge powder-coated steel, which has notable limitations in terms of the durability it provides in a school setting.

There is a solid plastic material, referred to as high-density polyethylene (HDPE), which can offer the more durable locker solution desired by design teams and maintenance staff. Lockers made from HDPE are able to: withstand exposure to moisture without rusting; survive rowdy student encounters without dents and dings; and easily wipe clean of graffiti without requiring paint. However, in today's specification climate, stronger lockers are only an acceptable solution if they offer a sustainable upside too. This article will take a deeper look at the improved durability of this material and the impact that product selection will have on satisfying the sustainable design criteria developed specifically for school applications.

THE LIMITED DURABILITY OF TRADITIONAL METAL LOCKERS

The traditional metal lockers selected to adorn school corridors for decades are made from 16-gauge powder-coated steel. Despite its prevalence in the K-12 application, this material is not the perfect solution for the space, in large part because the material has some

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Learning Objectives

After reading this article, you should be able to:

1. Compare the durability of traditional metal lockers with the durability of lockers made from a plastic material called high-density polyethylene (HDPE).
2. Describe the difference between post-industrial recycled content and post-consumer recycled content.
3. Summarize the contents of a health product declaration (HPD) and explore what an HPD for an HDPE product may contain.
4. Explain the contribution that HDPE lockers can make toward earning different green building certifications such as LEED™ and CHPS.

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Photo courtesy of Scranton Products. Cologne Academy, Cologne, MN.



HDPE lockers have earned GREENGUARD Gold certification and are recognized as a low-emitting material.

deficiencies that make it unable to hold up to the daily wear and tear of a school environment. Metal lockers may dent when impacted, rust when exposed to moisture, and removing tape and graffiti from the surface can be difficult. Unfortunately, collisions, wet conditions, and locker door drawings are all part and parcel of an average school day, leaving many in the design and maintenance community demanding a better, more durable locker solution than the traditional metal locker.

One such demand was heard from Lynne Peterson, executive director, Cologne Academy in Cologne, Minnesota. The charter school was expanding and one of the goals of the Facilities Task Force was to identify alternatives to the traditional metal lockers found in the corridors of the existing buildings. "It has only been five years since the Academy first opened and the metal lockers are already starting to look worn. We wanted to put a locker that would outlast and outperform the metal lockers in the new addition," explains Peterson.

Dents

Traditional metal lockers are typically less than 1/16 of an inch thick, thinner than a standard copper penny, making the locker panels susceptible to denting and damage from everyday impacts.

Rusting

As most high school chemistry textbooks will reveal, steel rusts when it comes into contact with water and oxygen. For a real world demonstration, many students need not look farther than the base of their locker. Simply pick up the snow boots dripping a melting mess of snow and salt on the bottom panel. This is a first-rate rust-causing concoction that can quickly corrode the locker surface wherever the paint-coat has been compromised.

In September 2011, flooding from Tropical Storm Lee devastated the Danville Middle School in Danville, Pennsylvania. In the aftermath of the storm, the auditorium was 8 feet under water and several feet of standing water were found in most classrooms, hallways, the library, the cafeteria, and the gymnasium. After only a few days, the metal lockers in the hallways were rusting from exposure to the contaminated floodwater and every single metal locker in the school had to be replaced.

Graffiti

The typical painted metal has low resistance to graffiti and attempting to remove ill-placed scribbles is often difficult and can leave a ghosting mark, which continues to compromise the overall aesthetic of the locker and can leave a facility manager with no other choice but to repaint the lockers.

INTRODUCING HIGH-DENSITY POLYETHYLENE (HDPE) LOCKERS

The more durable locker material demanded by designers and facilities personnel is now available. HDPE is one of the most commonly used plastics in the United States. It is regularly found in milk jugs, plastic bags, and yogurt cups. Solid HDPE is used to fabricate the lockers and can also be found in bathroom partitions, shower stalls, and playground equipment.

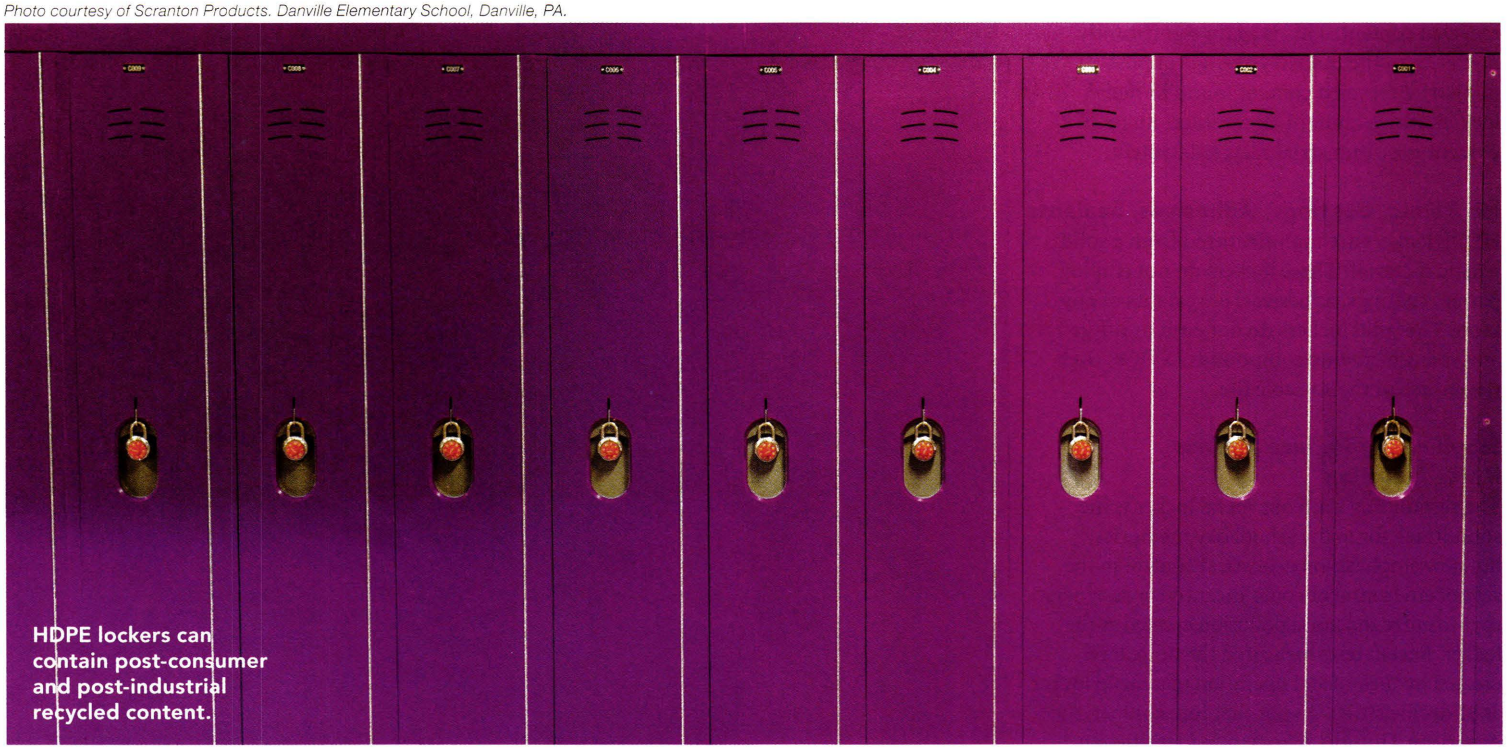
It is the solid nature of the HDPE used in the locker that gives this product its improved durability. HDPE lockers are made of ½-inch-thick rigid HDPE plastic, more than eight times thicker than the locker panels made of 16-gauge steel.

In order to quantify the difference in impact resistance offered by both locker materials, tests were conducted according to ASTM International standard D2444 (*Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup [Falling Weight]*). During these tests, a 100-pound weight was dropped on the traditional metal material and the HDPE material. The weight created a dent measuring 0.292 inches deep in the traditional metal surface and only 0.003 inches deep in the HDPE surface. The dent in the metal surface is more than 97 times deeper than the dent left in the HDPE surface.

Beyond a tougher exterior, the solid HDPE material will never delaminate or need painting because it is a solid piece of plastic that is uniformly colored throughout. The color is physically integrated into the material, not added on top of it at a later stage as a coating or laminate.

An HDPE locker provides an impermeable, non-porous surface that protects the locker from being damaged by water or graffiti. These lockers withstand exposure to moisture without corroding and, because the locker is made from plastic and not iron or steel, exposure to water will not cause the locker to rust. Graffiti wipes off easily with most non-abrasive cleaners. This can significantly reduce the time that facilities personnel must spend maintaining the lockers. As Robert Gannon, director of facilities at Ocean City High School in Ocean City, New Jersey, explains. "Maintaining metal lockers was a nightmare. When we installed HDPE lockers, we cut our maintenance time from three to four weeks to just two to three days. The amount of

Photo courtesy of Scranton Products. Danville Elementary School, Danville, PA.



HDPE lockers can contain post-consumer and post-industrial recycled content.

time spent on cleaning graffiti went from days to minutes. I couldn't be happier."

It should also be noted that HDPE lockers satisfy the fire rating for school corridors and are NFPA 286 compliant. Select manufacturers offer HDPE lockers that satisfy the fire rating.

Although the HDPE lockers offer widespread benefits to a school application as a result of the improved durability of the product, it is not enough to simply be stronger in today's building products marketplace. Designers are in need of the best product for the application in a package that contributes toward the green or sustainable design objectives of the project.

SUSTAINABILITY FEATURES OF AN HDPE LOCKER

Sustainable design is based around the tenets of creating buildings, schools, and interior spaces that are healthy, comfortable, productive, and environmentally friendly in terms of energy efficiency, materials usage, and even waste disposal. Student lockers made from HDPE contribute toward the goals of sustainable design in multiple ways. From being a fully recyclable product that can, in itself, contain a significant amount of recycled content, to protecting the quality of the interior environment as a low-emitting product and reducing the hallway noise pollution with softer operating noise levels, the HDPE locker solution supports sustainable design goals.

Fully Recyclable

A recyclable product can be remanufactured back into the original product or something else rather than heading for a landfill after its first useful life has ended. HDPE is easily recyclable and can be used again and again. Moreover, recycled HDPE creates no harmful emissions during its production or during its use.

Contains Recycled Content

Beyond being fully recyclable, an HDPE locker can contain products that were recycled, which is also referred to as a recycled-content product. This means that the HDPE locker contains items that have been diverted from the traditional waste stream, allowing used items to be re-used in an HDPE locker, instead of ending up in a landfill. The amount of recycled material in a product is typically stated as a percentage. A higher percentage indicates that more of the total product was created from recycled content.

New trends in green building and sustainable design programs are placing a growing emphasis on identifying the stage of use at which the product was sent to become recycled content. This has created different types of recycled content. Most commonly, recycled content is categorized as either post-consumer recycled content or post-industrial recycled content.

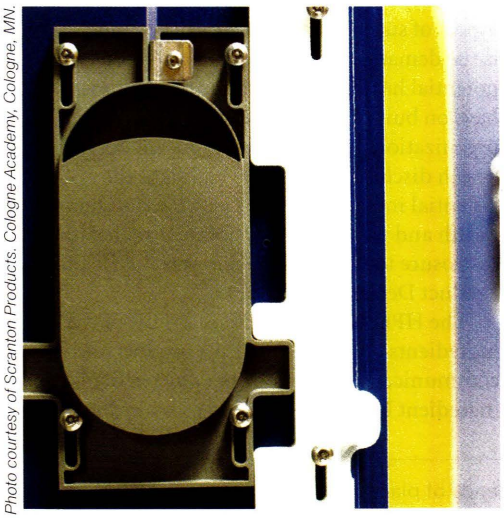
Post-consumer recycled content. Post-consumer material is defined as waste material that has been used by a consumer, disposed of, and diverted from landfills. It does not include waste generated during the manufacture and fabrication of a product.

HDPE lockers can be specified and manufactured to contain up to 100 percent post-consumer recycled material. This is significantly higher than the industry average of traditional metal lockers which contain, on average, up to 34 percent post-consumer recycled content.

Post-industrial/pre-consumer recycled content. For either fun or confusion, two interchangeable terms have emerged to refer to material that is being recycled from manufacturing waste. The two terms are post-industrial and pre-consumer. In either case, it refers to a material that essentially became waste in the manufacturing process of another product and, as such, was never used in an end-user capacity.

HDPE lockers typically contain between 25 percent and 75 percent of post-industrial

Photo courtesy of Scranton Products. Cologne Academy, Cologne, MN.



HDPE lockers do not require paints or coatings of any kind.

recycled content. This is again significantly higher than the industry average of post-industrial recycled content found in metal lockers which contain, on average, up to 28 percent post-industrial recycled content.

No Paints, Coatings, Adhesives, Sealants

HDPE lockers are manufactured from a solid plastic material. These lockers do not employ paints, coatings, adhesives, or sealants of any kind. The solid lockers do not emit or off-gas any volatile organic compounds (VOCs) over the course of their usable life.

Significantly Reduce Interior Noise Pollution

The resounding slam of a metal locker is the soundtrack for many school day memories, but new emphasis on acoustical control in the school environment could incentivize designers to minimize the noise pollution created at the locker. Recent tests measured the noise level created by the normal operation of a metal locker at 81 decibels(dB). To put that into context, the American Tinnitus Association identifies an alarm clock (2 feet away) as having a sound level of 80 dB. Alternatively, the noise level created by the normal operation of an HDPE locker was measured at just over 74 dB. This noise level is considered similar to that created by a washing machine or an average radio volume.

In terms of reducing potential noise pollution in the indoor environment, specifying HDPE lockers in a school corridor, instead of metal lockers would create a material difference. It is the difference between a hallway filled with buzzing alarm clocks or a hallway filled with whooshing washing machines. Renee Rudd, principal, Central Valley Academy High School, Ilion, New York, noticed a significant change in the amount of noise in the hallway after the metal lockers were replaced by HDPE lockers. "Before, the hallways were always filled with the metal-on-metal clatter of the locker doors opening and shutting. Now, you don't hear that. You hear the kids talking and you hear movement in the hallway, but you don't hear the rustle of lockers that you used to hear. It is much better."

Content Transparency

In the quest to create healthier spaces, designers want to know if a product poses a potential risk to the health and well-being of building occupants. They want to know if a product could negatively affect the interior environment and potentially cause an adverse reaction in a person who comes in contact with a product or spends time in the general area of a product. For example, there are thousands of products currently available for specification that emit VOCs, some of which, according to the Environmental Protection Agency (EPA), may have short- and long-term health effects. Designers want to be able to consider the potential health impact of a product, before it is specified into a building they are designing.

In response to these rumblings, another aspect of sustainable design gaining momentum is the demand to improve visibility to the potential health impacts that a product may have on building occupants. Non-profit organizations and manufacturers are developing health disclosure tools that highlight the potential impact a product may have on human health and well-being. One of the first health disclosure tools on the market was the Health Product Declaration™ (HPD).

The HPD contains an itemized list of the ingredients contained within a product and communicates whether or not any particular ingredient has been identified as hazardous or of concern. It should be noted that while the HPD attempts to convey whether or not the product contains any ingredients identified as hazardous, it stops short of addressing whether or not the use of a chemical in a product represents a meaningful risk to the people or the environment. This is an important distinction to make, because it is possible for a product to contain a hazardous material, but present no real risk to the health or well-being of the people manufacturing the product or the finished interior that contains the product. Nonetheless, the HPD does provide improved product transparency in terms of presenting the product contents and is a tool that specifiers, design teams, and building owners can use to make more informed decisions in choosing building products that contribute toward creating a quality interior environment and promoting the health and well-being of its occupants.

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Photo courtesy of Scranton Products. Danville Elementary School, Danville, PA.



Both the HDPE resin and the pigment ingredients in an HDPE locker have been classified as not hazardous by the OSHA Hazard communication definition.

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Active chilled beams have energy-saving potential in all building types.

Active Chilled Beams Come of Age

Architectural integration and application of this energy-saving technology meet sustainability and aesthetic goals

Sponsored by Price Industries | *By Jerry Sipes, Ph.D., P.E., Julian Rimmer, P.Eng., LEED AP, and Samuel Frenette, P.Eng.*

Building energy efficiency, sustainability, and interior aesthetics are concepts that may often appear to be at odds. Yet designers must balance these concepts within budget restrictions and energy code requirements—a feat, say industry experts, that will be increasingly hard to achieve. The "Annual Energy Outlook 2014" published by the U.S. Energy Information Administration (EIA) estimates that between 2012 and 2040, commercial building energy consumption will grow by 0.6 percent annually, while the growth of commercial floor space averages 1.0 percent per year and the energy intensity, or energy use per square foot, will decrease by 0.4 percent per year. This decrease is expected to come from federally mandated gains in equipment efficiency and reduced consumption by space heating, cooling, lighting, and plug loads. The key takeaway here is that, again, over time, it will become increasingly difficult to balance the energy code requirement, budget restrictions, and interior aesthetics.

How then can design goals be met while reducing energy?

Traditionally, most buildings have used air movement to transfer both the fresh air and thermal energy needed to properly heat, cool, and ventilate occupied spaces. Air, however, is not a very energy-dense media, and significantly



more air is often required to cool a space than to provide fresh air.

The requirement for high volumes of air to condition the building and the inherent inefficiency in moving air around the building have presented considerable challenges in using the traditional all-air HVAC design approach to meet increasingly restrictive energy codes. As a result, industry experts are exploring alternative methods. Water, for example, is often considered as the transport media of choice for energy-efficient thermal energy transfer. Water can store significantly more thermal energy per unit volume than the same volume of air, and because it has a higher energy density and a higher pumping efficiency, water requires less transport energy—by pump rather than by fan—to move thermal energy into and out of the occupied spaces. When used as the sole media to provide building heat and cooling needs, water has a lower operational cost than an equivalent all-air system. Of course, a certain amount of air movement is required for the proper ventilation of the occupied space. However, an air-water HVAC system that provides only ventilation-required air volumes can lead to an estimated reduction in building mechanical system power of 15 to 40 percent or more in some situations, depending on the overall system design.

ACTIVE CHILLED BEAMS—A PROVEN ALTERNATIVE

One alternative technology to an all-air system that is gaining traction is the active chilled beam, which incorporates the distribution of the ventilation air and uses room air induced across a water coil to transfer sensible thermal energy for both heating and cooling to the occupied space. When active chilled beams were first introduced in the North American market, they were limited by their capacity and their inability to meet aesthetic and architectural integration goals. Today's high-efficiency versions, however, can be seamlessly integrated in the buildings of the most demanding customers. In fact, active chilled beams have been used in Europe for over 20 years and were initially used primarily in high-performance office and educational buildings in the United States. As energy-efficient HVAC designs have become more common, many designers are using chilled beams in all types of buildings and finding that along with energy savings, occupant thermal comfort is also enhanced by better air distribution and thermal control of the occupied zone. The potential exists for chilled beams to have a significant role in both new construction and renovation of existing structures. Reed construction data indicates an increasing use of chilled beams in the U.S. market, with educational facilities and the commercial market representing the top two user groups. Healthcare facilities have just started using chilled beams as standards such as ASHRAE 170 *Ventilation of Healthcare Facilities* now allow chilled beams in patient rooms.

Benefits and Drawbacks

Active chilled beams may not be appropriate for all building/occupancy types, and their benefits and drawbacks should be evaluated in light of a particular application. Among their benefits, chilled beams have no internal moving parts and consequently little to no maintenance requirement compared to the traditional all-air VAV (variable air volume) system. They are also more efficient than their traditional VAV counterparts. A chilled beam system using a dedicated outdoor air system (DOAS) may see a reduction of 50 to 80 percent less primary air transport than that required in the traditional all-air VAV system. This lowered volume of primary air can lead to reduced floor-to-floor height as chilled beams do not need as much interstitial space for ductwork and have smaller mechanical room footprint requirements.

Due to the energy density of water compared to air, it takes about 1/10 the energy to move the same amount of thermal energy with water than air. Further, it is easier to achieve superior mixed air distribution with chilled beams—a scenario that leads to higher levels of occupant thermal comfort. In addition, when primary air is kept to a minimum, chilled beams offer quiet operation.

Despite their advantages, there is a lack of familiarity with chilled beams among MEP engineers, contractors, occupants, and building owners. The most common perceived issue is risk of condensation. However, this is not a concern if the mechanical system is designed to manage the dehumidification load and the building envelope has good control of moisture infiltration. Space is an important consideration. Chilled beams may occupy a higher percentage of ceiling area than traditional VAV, and space humidity sensors and condensate sensors are required for the best occupied space humidity control and least risk of condensation. In some instances, chilled beams are not appropriate, notably high-humidity (high latent load) spaces such as kitchens, and spaces

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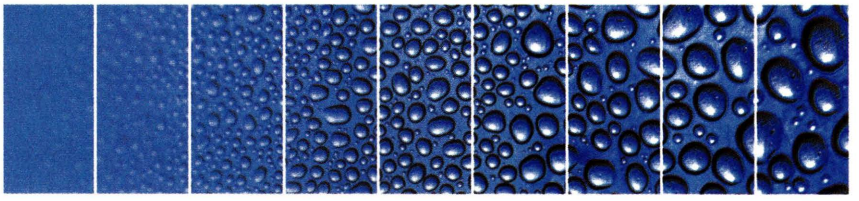
After reading this article, you should be able to:

1. Compare the energy efficiency of a traditional heating ventilating air conditioning system to a chilled beam system.
2. Discuss the design considerations of an active chilled beam in promoting an energy-efficient, aesthetic, cost-effective solution that meets green building goals and the safety and well being of building users.
3. Explain the issue of condensation and how it can be controlled for optimum functioning of an active chilled beam in the context of a sustainable application that supports indoor air quality.
4. Specify a chilled beam application that is appropriate for a particular building type in order to increase energy efficiency and enhance occupant comfort.

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Source: Mumma, 2002[1]



Condensate on panel with temperature differential

that experience high air volume change such as laboratories with fume hoods.

WHAT ARE CHILLED BEAMS AND HOW DO THEY WORK?

Chilled beams are of two basic constructions: passive and active. Passive beams are cooling-only devices that use gravity-driven natural convective cooling to condition the occupied spaces. Passive beams are typically installed along perimeters of buildings to try to intercept and condition most of the cooling load from the building shell before it reaches the occupied areas of the building.

Active beams are an induction device, where supply air is used to draw room air through a water coil. The air and water both provide cooling or heating depending upon the season. The water coils provide sensible cooling and the supply air handles the fresh air requirements and controls the occupied space humidity levels. The more optimally configured active chilled beam systems use only the ventilation minimum air volume, that is, fresh air, as the supply air; the rest of the sensible heating/cooling is provided by the water coil.

Condensation and Control

As most designers and end users have concerns about the potential for condensation, it is common for the designer to explore using a condensate pan as a safety feature even if the active chilled beam system is designed to not condense. Condensation is the heat transfer process by which water vapor is converted into liquid water, while condensate is the water that collects on the cold surface. The potential for condensate to form on a surface is determined by the difference of the surface temperature relative to the dew point of the air, which is the temperature at which water vapor in the air will become liquid water.

Surfaces with temperatures below the air dew point will form condensate. The rate at which the condensate forms is a function of how cool the surface is in relation to the dew point of the surrounding air, as well as the length of time the air is in contact with the cool surface. Since the space relative humidity is typically 50 percent or less, the risk of condensation can be mitigated by keeping the supply water temperature above the design room dew point. This dew point temperature of room air at 75°F and 50 percent relative humidity is ~55°F; therefore chilled surfaces above this temperature should not cause condensation. Engineers typically use a safety factor on this value to account for humidity and supply water temperature fluctuations; therefore supply water temperatures of 58°F are common. Interestingly, when room air is blown across a cold surface, the formation of condensate occurs at lower temperatures than the dew point because the air is moving and the air needs a longer duration of contact that the length of water coil fins used in active chilled beams. Since the cooling coils on a chilled beam are only two rows deep, the coil temperature may be significantly below dew point before water droplets form and fall from the coil fins.

When condensate forms, it is too late to prevent the surface from becoming wet. The question, however, is how to prevent condensate from becoming a design flaw in the building.

The HVAC designer needs to verify that the ventilation system is capable of handling the latent load. Humidity loads that must be addressed include:

- Ventilation load. Generally the largest moisture load, particularly in a humid climate.
- Infiltration load. Moisture that crosses the building shell through windows, cracks, and other penetrations. Non-operable windows and pressurization of the building can minimize this moisture source.
- Occupant load. As people breathe and perspire, moisture is released into the space.
- Other loads. Fountains, doors, and windows left open, wet clothing, etc.

It is important to note that around the world, many active chilled beams installed in humid areas do not have drain pans, nor do they need them. That said, most building codes have historically required drain/condensate pans for cooling coils. Recently, the chilled beam section at the Air-Conditioning, Heating and Refrigeration Institute (AHRI) filed an interpretation request with the International Code Council (ICC) concerning the requirement in the International Mechanical Code (IMC) that cooling coils must have a drain pan. In response, the ICC added an exception to the 2015 International Mechanical Code removing the condensate drain system requirement for cooling coils designed to operate in sensible cooling mode only and when a design strategy is used to prevent condensate formation on the sensible cooling coils.

How Chilled Beams Work

In a chilled beam, the term "induction" is used to describe the process of injecting primary air under pressure through a nozzle, which in turn entrains surrounding air at the discharge of the nozzle. The amount of air that is entrained vs. the amount of air injected is referred to as the induction ratio. It is important to note that the air pressures that cause this induction are very low so care must be taken when designing a beam (or tailoring a beam for a project) to ensure that there is as low a restriction as possible in the beam to keep the induction ratio high.

The induced air is drawn through a water coil that may either heat or cool the air before it comes in contact with the injected air discharging from the nozzle. The amount of energy transferred by the water coil is influenced by several factors, including the induced air temperature, water supply temperature, volume of induced air moving through the water coil, and amount of coil surface area.

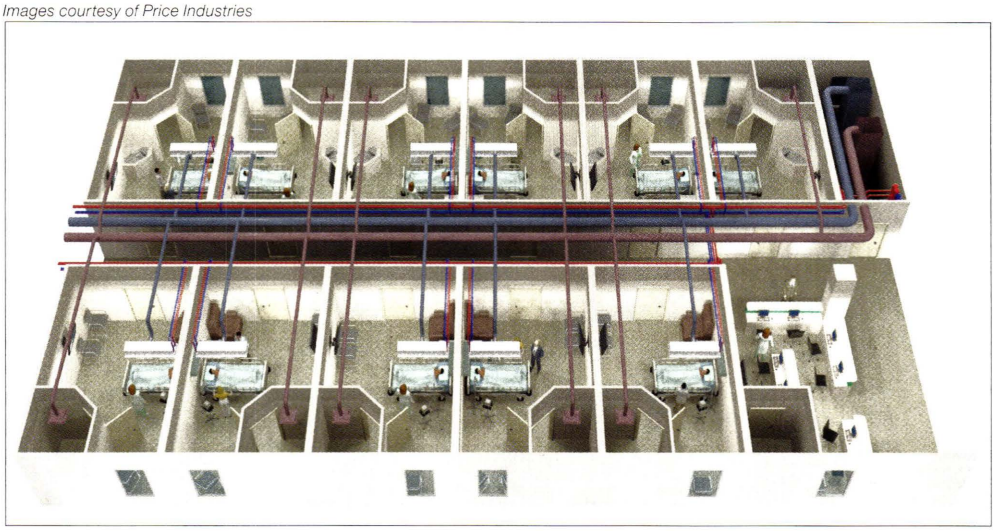
When designing a chilled beam system, one parameter that is often used is the transfer effectiveness (watts/cfm). This is the fraction of heating or cooling energy that is provided by the water coil heat transfer (q water coil) vs. the volume of primary air.

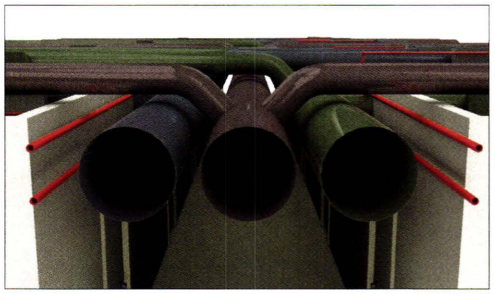
$$\text{Transfer Effectiveness} = \frac{\text{q water coil}}{\text{Q primary air}}$$

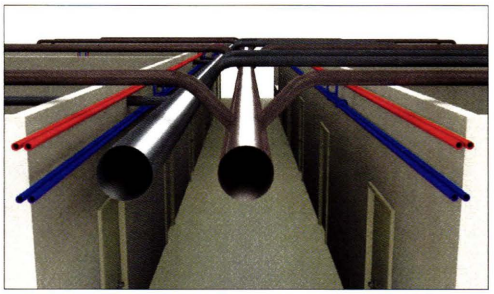
The transfer effectiveness is related to the overall HVAC system effectiveness. It takes less horsepower to move thermal energy with water than it does with air, as the volume of air needed is significantly larger due to the lower amount of thermal energy it can store. The potential saving is significant, but limited by the system choices made by the designer, as well as the primary air volume requirements. To reach the point of minimal energy consumption used to move air, the primary air volume would be no more than the requirements for fresh air.

Minimizing primary air volume is the

Images courtesy of Price Industries







Hospital patient room hall interstitial space for all-air HVAC system (supply, return, and exhaust) vs. hospital patient room hall interstitial space for an active chilled beam application (supply duct, exhaust duct, chilled water piping)

key to lowered HVAC brake horsepower and higher energy efficiency. Unfortunately, many designers only have experience with overhead mixing air distribution, which requires higher volumes of air, and do not feel comfortable lowering the primary air to the lowest level, leading to less than optimal energy consumption. For example, the accompanying table (see the online version of this course) shows the potential air volume reductions for several different building types. The smaller air-side load fractions indicate the potential for the HVAC designer to use minimal primary air and obtain higher energy savings due to the lowered brake horsepower consumption. If the designer is able to shift the bulk of the sensible load to the water, the building total brake-horsepower has the potential to be reduced to the lowest possible amount, leading to a more efficient design. For example, for an office space, the typical ventilation (outside air) requirements is around 0.15 cfm/sf, but the thermal loads (both sensible and latent) require an all-air system to use as much as 1 cfm/sf, creating a potential for a reduction of 85 percent of the primary air volume. In a classroom, a reduction of 67 percent is possible when designing at ventilation minimums.

As a reminder, the HVAC designer needs to verify that the ventilation air is capable of handling the zone latent load.

BENEFITS OF REDUCED PRIMARY AIR VOLUME

Active beams can supply[2] a significant portion of the sensible cooling or heating load of a building with a relatively low ventilation rate. In most commercial buildings, the ventilation rate required to condition the building can potentially be reduced by up to 85 percent of the ventilation normally required by an all-air system. A study by Weiger detailed the potential benefits of active chilled beams in a hospital setting. Chilled beam HVAC systems in non-surgical spaces such as patient rooms and office areas were found to have the potential to shorten the construction cycle and lower the cost, both initial and life cycle.[3]

On the scale of the overall system, the reduction in airflow will translate to a smaller air handler and smaller duct network. The reduction in system size may allow a lower floor-to-floor height as well as an increase in usable space on each floor due to a reduced footprint of the mechanical shafts. In certain building types such as healthcare facilities, reducing the congestion in the interstitial spaces will speed construction and allow for more usable floor area due to the significant reduction in the riser spaces needed. Weiger found that the cross sectional ductwork could be reduced by 75 percent with a corresponding reduction of 50 percent material ductwork cost. The riser footprint was reduced by 50 percent and savings in mechanical room footprint was estimated at 25 percent.

The reduction in riser and mechanical room footprints frees that area to be used in revenue-generating activities such as patient rooms. The reduction in riser footprint could in fact allow for an additional patient room on each floor with essentially no additional cost when compared to using a traditional all-air HVAC system. In healthcare applications, when the system is designed to provide 100 percent fresh air at code-required volumes to patient rooms, the return duct may actually not be needed as the exhaust air volume from the patient room bathroom often matches the room supply. It should also be noted that the installation of the ductwork in patient wards is complex and often requires significant coordination and stops and starts from the sheet metal contractors as they allow for other services to be installed. With less ductwork, a common result is that the mechanical system is taken off the critical path of the construction of these wards.

ENERGY SAVINGS POTENTIAL

How much energy can really be saved by active chilled beams? There is no easy answer due to the many systems and possible combinations of equipment available to provide the cooling or heating water. To optimize the choice, designers must consider factors directly related to the HVAC mechanical system energy consumption including: the building geographic location; outdoor humidity levels; occupancy type/schedule; the type/source of hot/warm water; and the potential for primary air volume reduction.

See endnotes in the online version of this article.

Continues at ce.architecturalrecord.com

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CIRCLE 75

Photo courtesy of Longboard – a division of Mayne Coatings Corp.



Aluminum cladding systems provide a range of metallic and wood-grained appearances, the ability to use high-performance continuous insulation, and fully coordinated soffits and fascia.

Innovations in Aluminum Cladding Systems

Designing long-lasting, low-maintenance, energy-efficient, sustainable buildings

Sponsored by Longboard – a division of Mayne Coatings Corp.

The reduction of fossil fuel-based energy continues to be encouraged by national and local organizations that ultimately seek designers to create net-zero energy buildings. While this remains a top priority, aesthetics still play a vital role in design decisions. Dovetailing these two concerns can become a design balancing act, but in recent years building materials and systems have evolved, offering the architectural community an ever-broadening array of options in creating visually appealing, eco-friendly structures.

Aluminum exterior wall systems are a prime example of that evolution. Originally seen as a new and innovative breakthrough, aluminum quickly became a commonplace building material that has experienced a new surge in popularity due to its composition of recycled content and recyclable attributes. It is routinely used in many interior and exterior building applications due to its light weight, high strength, durability, and easy fabrication. It has even become possible to finish it so it looks like anything but metal. Today, aluminum products can be specified that are finished to look like wood-grained materials, creating striking visual effects in both commercial and residential buildings in the United States and Canada.

In addition to the visual appearance changes, aluminum can be used as part of an innovative cladding support system. Such a system can also allow for the installation of continuous insulation to meet the requirements of energy codes and standards. Altogether, a fully coordinated aluminum wall system directly impacts energy use in buildings, contributes to green and sustainable design, and provides great aesthetic value as well. This article will discuss how all of these aspects can come together successfully.

THE DRIVE TOWARDS ENERGY REDUCTION

Energy use in a building is directly related to the design of the building envelope, and often to the design of the exterior walls in particular. Common wall construction systems suffer from the classic problem of thermal imperfections where insulation material is interrupted by wall framing, floor slabs, corner conditions, or any number of other construction items. These interruptions create "thermal bridges" between the inside and outside which effectively reduce the overall thermal performance of the wall. For example, a conventional stud framed wall that uses insulation

Photo by Dale Klippenstein



Aluminum cladding with wood grain appearance can be used effectively on commercial buildings.

between the studs may carry a manufacturer's "nominal" R-value rating of R-19. However, the other materials in the assembly can have a much lower or negligible R-value and account for as much as 20 percent of the total wall surface. The result is an "effective" R-value for the total wall that is closer to R-10 or even less, meaning the wall is less effective thermally and the building will likely need more energy to operate.

The International Energy Conservation Code (IECC) and ASHRAE 90.1 have become the most recognized standards in North America for identifying minimum conditions for energy use reductions in buildings. Both standards recognize the negative impact of thermal bridging on a building's energy performance. Therefore, these standards encourage and sometimes require that these negative effects be mitigated through the use of continuous insulation (ci) to demonstrate code compliance. Specifically, ASHRAE 90.1 defines continuous insulation as "insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior, exterior, or is integral to any opaque surface of the building envelope." As a practical matter, continuous insulation is commonly installed between the exterior wall sheathing (or comparable surface) and the final exterior cladding or finish material. In so doing, the ci avoids most other construction items and supplies the needed unbroken layer of insulation across the entire wall assembly. Of course, it is up to local jurisdictions to adopt specific versions of energy codes, so details and requirements can and do vary somewhat depending on the location of any particular building. Nonetheless, green building rating systems and other initiatives that seek to achieve energy performance beyond code-required minimums, also recognize and actively promote the effective use of continuous insulation to the fullest extent.

Incorporating continuous insulation on the outside of conventionally framed wall systems has a dramatic effect on the thermal performance of that wall assembly. But the effectiveness of continuous insulation becomes even more pronounced on multistory buildings where a stud wall assembly is used on multiple floors. The studs commonly rest on and get anchored to a floor structure that, for example, could be made from 4 to 6 inches of concrete in a metal deck or from a 10-inch to 12-inch wood framed structure. In this type of construction, the insulation in the wall studs stops above and below the floor structure meaning the floor edge is exposed along the full length and width of the building. The floor becomes a very significant

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Learning Objectives

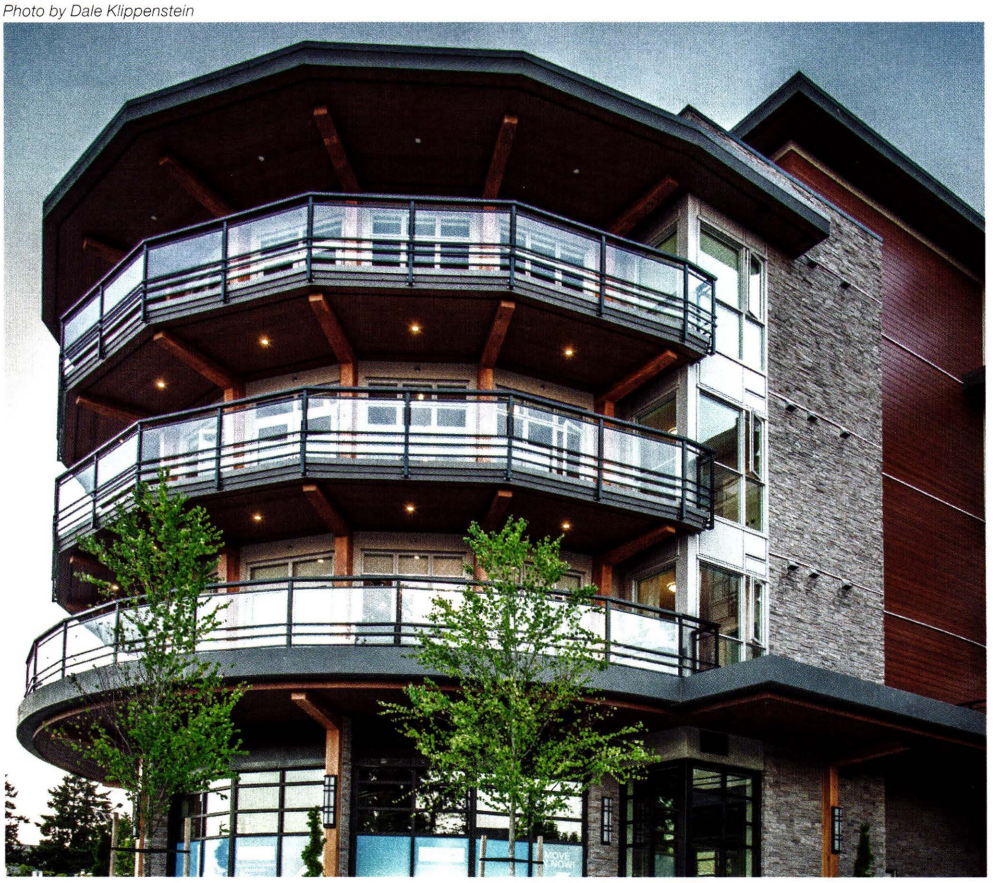
After reading this article, you should be able to:

1. Define continuous insulation (ci) and the areas on a building where it can effectively improve thermal performance.
2. Describe the code and fire performance attributes of aluminum.
3. Explain the benefits of an aluminum back-framing cladding system as it relates to building thermal performance.
4. Discuss the green and sustainable attributes of fabricating and specifying aluminum cladding with wood grain appearance.

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AIA/CES K1501H

Photo by Dale Klippenstein



LEFT: Aluminum cladding and siding products provide a durable and sustainable solution for building façades of all types.

thermal bridge since there is often nothing to prevent heat from being transferred between the inside and the outside of the building along the entire perimeter of the floor construction. The obvious means to overcome this deficiency is to insulate this edge as part of the overall continuous insulation scheme of the building envelope.

The same type of thermal bridging phenomenon occurs elsewhere in the building envelope as well. Structural elements such as columns or beams made of steel or concrete can create very significant thermal breaks if they are not fully insulated. This applies not only to walls but to roof elements too, such as roof parapets which can act in the vertical plane the same way exposed floor slabs act in a horizontal plane. The ideal solution is to make sure that continuous insulation connects at all of the critical junctures between building assemblies such as the wall and roof junction, parapets, soffits, and fascia.

THE ROLE OF ALUMINUM

Aluminum has been produced commercially for about a century, offering a number of advantages as a building material. Malleable and ductile, it machines and casts easily, offers superior resistance to corrosion, and is about one third the weight of steel and copper. Aluminum is also a low-maintenance, highly durable material. Aluminum's structural strength and stability is consistently high, even under extreme conditions and temperature changes. Where plastics may become brittle at low temperatures, aluminum actually becomes even stronger at extremely cold temperatures, which is why NASA chooses it for many aerospace applications. According to the Aluminum Association, aluminum is 34 times stronger than vinyl, 43 times stronger than wood, and when appropriately alloyed and treated, can be stronger than some steels.

Aluminum is also valued for its recyclability. According to the Aluminum Association, a 2008 survey of producers found an 85 percent recycled content rate for U.S. flat rolled products for the building industry, with some 60 percent from post-consumer sources. Individual producers may be able to provide aluminum with higher percentages. At the end of its service life, many aluminum construction elements can be recycled into like products without a loss in quality. From an energy standpoint, the recycling process only requires 5 percent of the energy used to produce the metal from its origin as bauxite ore. Recycling 1 ton of aluminum, in fact, saves 4 tons of bauxite with associated reductions in air pollution of 95 percent and water pollution by 97 percent.

Aluminum extrusions in particular offer a number of advantages. Because of its lighter weight, extruded aluminum is less costly to ship and easier to handle. Its malleability enables aluminum to be extruded not only in standard profiles but in a myriad of custom profiles geared to the aesthetic or functional objectives of the architect and owner. The extrusion process enables the inherent strength to be intensified where needed, by adjusting the thickness of the extrusion or reinforcing certain parts of the profile. The tooling for the extrusion process is inexpensive relative to that of other materials and can be quickly accomplished. Designed effectively, aluminum extrusions can greatly simplify subsequent fabrication and assembly. As such there is a wide variety of fabrication processes that are routinely employed in the production of extrusion-based components and assemblies.

Most aluminum products, like most metals, are actually alloys that add other minerals to achieve different physical properties. National standards developed in conjunction with the Aluminum Association identify different alloys by numeric designations. Extruded architectural

Photo by Dale Klippenstein



Aluminum wall cladding can take many forms including horizontal siding used on residential and commercial buildings.

aluminum falls within the 6000 series designation, with 6063 being the most popular for building materials like aluminum siding, cladding, and soffit materials. The characteristics of the 6000 series include good finish, surface strength, and corrosion resistance.

Aluminum is also non-combustible and non-toxic even at high temperatures. Independent testing reports confirm the non-combustibility of certain coated aluminum extrusions and their compliance with ASTM E2768-11, Standard Test Method for Extended Duration Surface Burning Characteristics for Building Materials (30-Minute Tunnel Test). The examination includes three tests: the flame spread index; Smoke Developed; and Extended 20-Minute Burn. Test results are reported via indices that compare the sample to graded red oak flooring and inorganic-cement board. In the first test, the rate of progression of a natural gas flame applied to the start of a sample product is measured in a 25-foot tunnel. Secondly, a photocell measures the amount of light obscured by the smoke in the tunnel. When the smoke from a burning sample blocks out the light, the photocell output dips, and is recorded against the red oak results. Lastly, consistent with ASTM E2768, the test continues for another 20 minutes and the flame front is measured. Because aluminum does not typically burn in these test conditions, it is considered a non-combustible material for construction. However, aluminum alloy will melt at 1,200°F but without emitting hazardous gases. The aluminum cladding being increasingly used on industrial roofs and walls is actually intended to take advantage of this and to melt during a fire, so that heat and smoke can escape to reduce damage to the building.

HIGH-RISE BUILDING USES ALUMINUM WALL SYSTEM FOR HIGH PERFORMANCE

PROJECT: Broadway and Pacific Mixed-Use Development
LOCATION: San Diego, California
ARCHITECT: Chris Dikeakos Architects, Inc.



Image courtesy of Chris Dikeakos Architects, Inc. and Keith Panel Systems

A new, signature skyscraper in the vibrant Southern California city of San Diego is scheduled to break ground in early 2015. The striking building will feature 39,000 square feet of 6-inch V-groove aluminum cladding and soffit material in a light ash finish. To achieve the desired performance, it will also use a complete back-framing system that includes continuous insulation. Mike Alivojvodic, architect AIBC, MRAIC, and principal at Chris Dikeakos Architects, Inc., says the materials were specified to achieve the look of a wood soffit material, and to meet the stringent code requirements for fire ratings and wind suction loads. "The product looks like real wood slats," says Alivojvodic. "The selection of widths and application for both color and grain choices was very good, and the design for all the major soffits on the project called for 'woodlike' slats that are reminiscent of cedar or fir soffits. The finished aluminum products achieve this without having to worry about regular maintenance that is associated with real wood."

Alivojvodic acknowledges that while the product chosen is relatively new in the marketplace, manufacturer's reps were helpful in providing technical data on general items as well as very specific issues that needed to be resolved before he would be comfortable in specifying the product. "The back-framing system is key to making the product work in this design as it provided for a clip-on installation without seeing gaps and/or surface mounting elements like the other products that were considered," he says, noting that "the length and width were much more conducive to the application than the modular nature of the others." Summarizing, Alivojvodic says that "aside from the look being achieved, the product met fire regulations, it can be engineered to deal with wind loading issues, and the finished product allows for a flush installation without the need for surface attachments."

ALUMINUM BACK-FRAMING SYSTEMS

Combining the need for energy efficiency and the benefits of aluminum has led to an interest in finding ways to use aluminum exterior cladding or ventilated rainscreens over continuous insulation. The challenge of course is how to secure the exterior cladding without compromising the continuous insulation with fasteners and supports. An innovative solution can be found in aluminum "back-framing" systems that can secure the metal cladding to the primary wall with minimal disruption to standard insulation products. Such a system also needs to contain its own thermal break to avoid adding thermal bridges through the fasteners to the wall assembly. Back-framing systems that incorporate thermally broken aluminum clips for attaching aluminum cladding to the primary wall assembly and integrate continuous insulation offer the best potential to boost building energy performance and occupant comfort. Offering the most flexibility are framing systems designed for non-combustible mid- and high-rise building envelopes whether the primary walls are steel framing, stud walls, block, or concrete. Similarly, systems that can accommodate different continuous insulation thicknesses, generally 3, 4, 5, and 6 inches, offer more options to optimize energy performance.

In order to evaluate the thermal performance and wind load resistance of such a back-framed system, the independent testing laboratory Morrison Hershfield has tested such a system on various types of backup or primary walls. Performance of this system was validated through modeling and the finite element analysis (FEA). The tested system consists of a thermally broken aluminum T-clip and an extruded aluminum sub-girt for attaching rainscreen cladding systems to the primary walls. The aluminum T-clips are fastened directly to the primary wall at a spacing that can match wall framing or to accommodate standard widths of continuous insulation products (i.e. 2-feet-0-inch on center). The T-clips project out horizontally from the wall and include a thermal break in the base to thwart thermal bridging between the wall and the clip. The depth of the T-clip is equal to the depth of the continuous insulation used. Along the outside end of the T-clip, thin sub-girts are fastened to run vertically so they are parallel to the wall.

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Frank Lloyd Wright: American Icon, Architectural Master, Modern Dreamer

Sponsored by PPG Paints

Frank Lloyd Wright (1867-1959) is recognized and revered worldwide as one of the greatest architects of the 20th century. His work heralded a new thinking in architecture, using innovation in design and engineering made possible by newly developed technology and materials. His creative ability extended far beyond the border of architecture to graphic design, furniture, art glass, textiles, and decorative products for the home.

This course looks at the professional life of Frank Lloyd Wright—true American icon, highly influential architectural master, and all-around modern dreamer. It illustrates his influence on, and achievements in, modern design, and ends by providing an in-depth review of his body of work resulting from his time at Taliesin West.

CONTINUING EDUCATION

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Learning Objectives

After reading this article, you should be able to:

1. Discuss the career of Frank Lloyd Wright as an architect and designer, and understand his influence on modern design.
2. Describe the important periods of Wright's career, his impact on the design of his time, and his inspiration of other architects and designers.
3. Explain the influence Wright has had on product designers, even those of today.
4. Review Wright's process for design and color selection at Fallingwater.
5. Describe the color palette used at Taliesin West.

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Illustration of Frank Lloyd Wright's Fallingwater®

Images courtesy of OBMA, © Wright Foundation (top inset); Western Pennsylvania Conservancy, Mill Run, PA (bottom)

THE CAREER OF A MASTER

We begin by looking at an overview of Frank Lloyd Wright's career, which spanned the course of more than seven decades between the 1890s and the later 1950s.

While there are many great quotes credited to Wright, for the purposes of this presentation it is fitting to reference one quote in particular: "Every great architect is—necessarily—a great poet. He must be a great original interpreter of his time, his day, his age."

Wright embodied this spirit in every aspect as he approached any and all realms of design. To him, design was not something solely attainable by the elite, but rather an essential part of every area of life. This belief was evident in his design philosophy, which can be summarized in four words that are related and yet distinct, and, of course, utterly meaningful when it comes to design. These four words are: unity, simplicity, harmony, and integrity.

Continues at ce.architecturalrecord.com

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Photo courtesy of Draper Inc.



The projection screen is a major influence on the quality of the viewing experience.

Projection Screens Made Simple

The basics of providing a maximum viewing experience

Sponsored by Draper Inc.

Audiovisual (AV) communication is critical in today's world. Business, medicine, entertainment, and education are just a few fields that depend on AV technology to inform, teach, and train their constituents. Rather than the traditional lecture model, AV creates a stimulating and interactive environment which is more conducive to learning. According to the U.S. Department of Labor OSHA Office of Training and Education, "retention of information three days after a meeting or other event is six times greater when information is presented by visual and oral means than when the information is presented by the spoken word alone."

Maximizing the learning potential of the AV experience involves designing an effective projection environment. Today, that environment depends heavily on the right projection screen, even more so than the type of projector. There are many types of projection screens on the market today, but effective screens share a common trait: They reproduce an image so that everyone in the room can see it—or read it—easily. Choosing the screen that can attain that objective can be a complicated process however. This article will present an overview of projection screens and serve as a primer on the various factors that must be considered in selecting the appropriate screen for a given situation.

WHAT YOU NEED TO KNOW: THE BASICS

Effective purchasing decisions depend on a variety of factors, including budgetary considerations, the size of the room, type of presentation, as well as more technical concerns including the screen type, screen size, aspect ratio, screen model, and viewing surface for the application. Before a projection screen can be properly selected, systems designers must know what type of content will be viewed and if the system will be used in various ways.

Continues at ce.architecturalrecord.com

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Learning Objectives

After reading this article, you should be able to:

1. Discuss the various factors that must be considered in selecting or specifying a projection screen for a specific project.
2. Identify four viewing categories that conform to standardized ANSI/ INFOCOMM 3M-2011.
3. Explain the implications of the relationship between the gain of the screen surface and the projector throw distance ratio on image quality.
4. Specify the correct screen format, size, model, and viewing surface for a given type of presentation.

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AIA/CES COURSE #K1312D

DRAPER®

Draper, Inc., is a Spiceland, Ind.-based manufacturer of projection screens, lifts for projectors and flat panel displays, video conferencing solutions, and window shades. Draper has more than 50 years of experience in the audiovisual industry. **www.draperinc.com**

CIRCLE 60

Originally published in the December 2013 issue of Architectural Record

Anodized Aluminum for Architectural Applications

Durable, strong, versatile and cost effective with extensive color and finish choices, anodized aluminum sets trends with a multitude of applications

Sponsored by Lorin Industries | *By Karin Tetlow*

Nearly a century ago, aluminum revolutionized the world of metals. Since then, coil anodizing technology has allowed remarkable architectural possibilities of designs, textures, and finishes that are functional, versatile, and environmentally responsible. Anodized aluminum can be roll-formed, stamped, laser engraved, laminated, perforated, welded, embossed, and silk-screened. Moreover, recent breakthroughs in coloring techniques provide a range of colors rivaling those of paint. Among the many applications of anodized aluminum are architectural exteriors, interiors, paneling, roofing, windows, doors, ceilings, and lighting.

Continues at ce.architecturalrecord.com

Anodized aluminum cut-out honeycomb panels in the Gyeongju Tower in Gyeongju, South Korea, echo the legendary Hwangnyongsa Temple's wooden pagoda (see case study online).



Photo courtesy of Lorin Industries

CONTINUING EDUCATION

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Learning Objectives

After reading this article, you should be able to:

1. Describe aluminum anodizing and explain the differences between types of anodizing processes.
2. List the advantages and disadvantages of coil and batch anodized aluminum.
3. Summarize the advantages of coil anodized aluminum compared with other metals and coatings.
4. Identify applications that use coil anodized aluminum products for architectural interior and exterior uses.
5. Discuss the sustainable and environmental characteristics of anodized aluminum.

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Lorin Infinite possibilities

Lorin Industries is a leading manufacturer of high-quality aluminum coil anodizing since 1943, specializing in offering original equipment manufacturers a protective and decorative aluminum finish. Lorin Industries' technology provides an almost infinite number of aluminum finishing options for multiple applications, giving architects and designers flexibility in architectural design. **www.lorin.com**

CIRCLE 63

Originally published in the November 2013 issue of Architectural Record

CONTINUING EDUCATION

Smart Safety Design to Prevent Slips, Trips and Falls

Sponsored by SlipNOT® Metal Safety Flooring

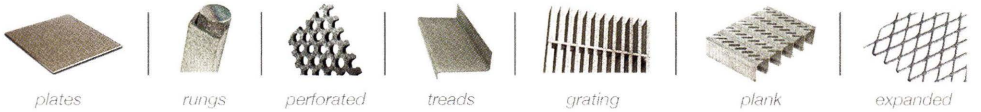
COURSE SUMMARY

Half of slip and fall accidents are caused by flooring. Moreover, slips, trips and falls from floors and walkways are the leading cause of median days away from work and workplace illness and injury. This interactive course lists slip-resistant standards and methods for testing flooring surfaces. It describes the key areas in industries where slip resistance is critical and the factors design professionals should consider when looking for flooring. The pros and cons of different materials, products and methods are explored. The course concludes with a step-by-step process for achieving building occupancy safety and developing an OSHA- and ADA-compliant safety plan.

▶ This course is an online distance learning continuing education presentation. Go to the Architectural Record CE Center at ce.architecturalrecord.com to view the course and take the test to earn AIA/CES credit.

Photo courtesy of A&B Process Systems





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Learning Objectives

At the end of this course, you will be able to:

1. Explain the difference between a slip, trip and fall.
2. List four causes of slips, trips or falls.
3. Identify the main (50 percent) cause of injury in the workplace.
4. Determine what is the largest "source" of workplace injury.
5. Identify the median amount of days away from work due to floor, walkway and ground surface injuries.

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CIRCLE 62



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Ongoing Exhibitions

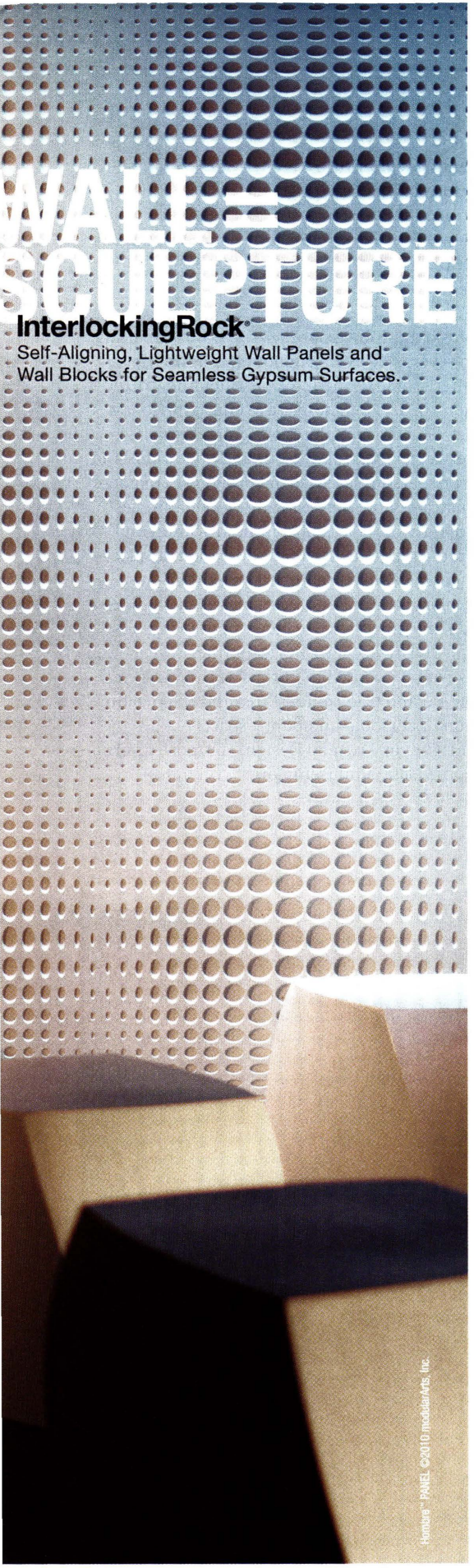
Make a Joyful Noise: Renaissance Art and Music at Florence Cathedral
Atlanta
Through January 11, 2015
Three marble panels from Italian sculptor Luca della Robbia's famed organ loft created for Florence Cathedral travel to the High Museum of Art, their first time in the U.S. The High's exhibition places these panels in an environment like the one for which they were originally created by displaying them with other musical objects, including hand-decorated choir books from the cathedral and a lectern to hold them. For more information, visit high.org.

Assembled Realities: Jeff Chien-Hsing Liao's New York
New York City
Through February 15, 2015
A portrait of New York as seen through more than 40 large-scale panoramic photographs of the city's urban landscape, *Assembled Realities* features work by Taiwanese artist Jeff Chien-Hsing Liao, who came to New York at age 18 to study photography. Pushing the boundaries of traditional documentary photography, Liao creates large-scale panoramas by combining multiple exposures of the same location taken over the course of several hours. At the Museum of the City of New York. For more information, visit mcny.org.

Found in Translation: Palladio–Jefferson
Montreal
Through February 15, 2015
Found in Translation: Palladio–Jefferson presents recent work by the documentary and architecture photographer Filippo Romano. The exhibition presents a visual narrative tracing the principles of 16th-century Italian architect Andrea Palladio (1508–80) as they appear in buildings designed by American President and architect Thomas Jefferson (1743–1826), who saw Palladio's work as a model for architecture in the newly independent United States. The project attempts to shape a less conventional perspective on Palladio—whose buildings are among the most photographed in history—while also revealing the conditions of dissemination and translation behind Jefferson's adaptations of Palladio's *I Quattro Libri dell'Architettura (The Four Books of Architecture)* two centuries after they were written. For more information, visit cca.qc.ca.

New Territories: Laboratories for Design, Craft and Art in Latin America
New York City
Through April 5, 2015
This exhibition examines the state of making in several cities throughout Latin America, where some of the most pertinent new directions in arts and design are emerging today. *New Territories* explores the collaborations between small manufacturing operations and craftspersons, artists, and designers, and demonstrates how the resulting work addresses not only the issues of commodification and production, but also of urbanization, displacement, and sustainability. The exhibition explores a number of key themes, including the dialogue between contemporary trends and artistic legacies in Latin American art; the use of repurposed materials; the blending of digital and traditional skills; and the reclamation of personal and public space. At the Museum of Arts and Design. For more information, visit madmuseum.org.





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Ways to Modernism: Josef Hoffmann, Adolf Loos, and Their Impact
Vienna
Through April 19, 2015
With *Ways to Modernism: Josef Hoffmann, Adolf Loos, and Their Impact*, at the Museum for the Applied Arts, legendary works of Josef Hoffmann and Adolf Loos offer a portrayal of the development of Viennese modernism into a global brand. The two designers developed contrary alternatives for modernity in art, architecture, and design; their work is shown in tandem, allowing viewers to draw comparisons between their approaches. *Ways to Modernism* focuses not only on the thinking and key works of these two visionaries, but also the historical background of their ideas, and the continued resonance of their work in architecture and design. In addition to the late œuvre of Hoffmann and Loos, the exhibition features works by Oskar Strnad, Josef Frank, Margarete Schütte-Lihotzky, Atelier Singer-Dicker, Bernard Rudofsky, Hans Hollein, Hermann Czech, Lacaton & Vassal, Werner Neuwirth, and Anna Heringer. For more information, visit mak.at.

One Way: Peter Marino
Miami Beach, Florida
Through May 3, 2015
American architect Peter Marino has been celebrated over the past four decades for his forward-thinking work, which exists at the intersection of art, fashion, and architectural design. Curated by Jérôme Sans, this exhibition, at the Bass Museum of Art, explores the interplay between Marino's iconic architectural designs and his personal collection of contemporary art, which includes pieces by Loris Gréaud, Keith Haring, Richard Serra, Rudolf Stingel, and Andy Warhol. A handful of artists, Gregor Hildebrandt and Erwin Wurm among them, will also present new work commissioned for the exhibition. For more information, visit bassmuseum.org.

Sink or Swim: Designing for a Sea Change
Los Angeles
Through May 3, 2015
Through the work of a select group of architectural, fine art, and news photographers, *Sink or Swim* casts an eye on both the problem of climate change in densely populated coastal regions and contemporary design as a means to navigate the changing landscapes. It explores the story of resilience, from adaptation for human survival to ambitious infrastructure planning, in some of the world's richest and poorest coastal communities. Curated by architecture writer and radio host Frances Anderton with the Annenberg Space for Photography, *Sink or Swim* features newly commissioned and archival works by photographers Iwan Baan, Stephen Wilkes, Paula Bronstein, Jonas Bendiksen, and Monica Nouwens. Images show highly complex coastal flood mitigation in the Netherlands, controversial sea walls in Japan, and innovative homes and community buildings by leading architects including Thom Mayne, Toyo Ito, and Shigeru Ban. For more information, visit annenbergspaceforphotography.org.

The Architectural Image, 1920–1950: Prints, Drawings, and Paintings from a Private Collection
Washington, D.C.
Through May 3, 2015
Between 1920 and 1950, architecture changed more profoundly and more rapidly than during any similar timespan in history. The changing tastes, theories, and obsessions of that era were often documented by prominent artists who found architecture and construction to be compelling subject matter. The National Building Museum presents an exhibition of 70 prints, original drawings, and paintings from this period in architectural history, drawn from the collection of David M. Schwarz, a prominent Washington, D.C., architect. The works reveal an enduring fascination with architectural and engineering imagery and offer glimpses into the artists' personal impressions of the built environment. Included are works by artists Howard Cook, Louis Lozowick, and Charles Turzak. For more information, visit nbm.org.

Sagrada Familia—Gaudí's Unfinished Masterpiece: Geometry, Construction and Site
New York City
Through May 8, 2015
The Bernard and Anne Spitzer School of Architecture at City College of New York is hosting an exhibition of Antoni Gaudí's Sagrada Familia in its Atrium Gallery. The exhibit includes several architectural models and casts used in construction, and showcases the three-dimensional computer-imaging software used to analyze and draw precise tridimensional geometry. For more information, visit ssa1.ccny.cuny.edu.

Uneven Growth: Tactical Urbanisms for Expanding Megacities
New York City
Through May 10, 2015
As the world's population approaches 8 billion, city authorities, urban planners and designers, economists, and many others will have to join

forces to ensure that expanding megacities remain habitable. To engage this international debate, *Uneven Growth* at the Museum of Modern Art showcases the work of six interdisciplinary teams who present new architectural possibilities for global metropolises Hong Kong, Istanbul, Lagos, Mumbai, New York, and Rio de Janeiro. The resulting proposals show how emergent forms of tactical urbanism can respond to alterations in the nature of public space, housing, mobility, and other issues in near-future urban contexts. For more information, visit moma.org.

Lectures, Conferences, and Symposia

2015 SAH Annual International Conference: Chicago at the Global Crossroads
Chicago
April 15–19, 2015
The Society of Architectural Historians (SAH) will celebrate its 75th anniversary during this conference, which includes lectures, roundtables, and 36 paper sessions covering topics in architecture, art and architectural history, preservation, landscape architecture, and the built environment. SAH is committed to engaging both conference attendees and local participants with public programming that includes more than 30 architectural tours, a plenary talk, and a half-day seminar addressing Chicago's waterways and neighborhoods. For more information, visit sah.org/2015.

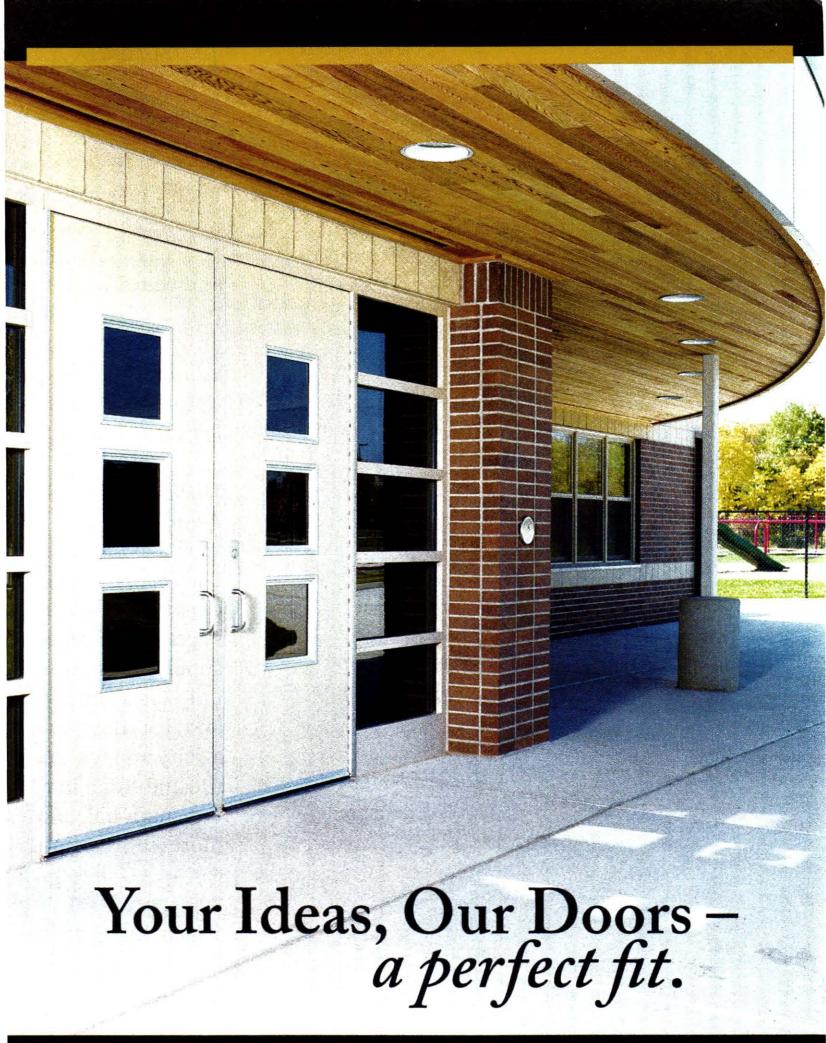
Competitions

2015 Modernism in America Awards
Early submission deadline: January 9, 2015
DOCOMOMO US invites submissions for the 2015 Modernism in America Awards. The awards recognize building owners, design teams, and advocacy/preservation organizations that have made significant efforts to retain, restore, and advocate for the aesthetic and cultural value of modern buildings, structures, and landscapes built in the United States or on U.S. territory. Awards will be presented in the following categories: design (residential, commercial, and institutional/civic architecture), inventory/survey, and advocacy. For more information, visit docomomo-us.org.

Folly 2015
Submission deadline: January 12, 2015
The Architectural League and Socrates Sculpture Park invite emerging architects and designers to submit proposals for *Folly*, an annual design/build studio program during March and April 2015 leading to a public exhibition opening in early May 2015 at Socrates, a waterfront park. Applicants are encouraged to visit Socrates, located in an industrial area of Long Island City, Queens; proposals should address the site's rugged urban environment. Both individuals and firms may apply. For more information, visit archleague.org.

International Architecture Awards
Registration deadline: January 15, 2015
This program seeks to reward design excellence from all over the world. Prominent architects act as jury members to choose the most notable built or conceptual work in the fields of architecture, landscape/urban design, and interior design. There are 36 categories, and judges will select three winning projects from each for a total of 108 awards. The categories range from commercial and institutional projects to private residences. For more information, visit architecturepodium.com.

International Wildlife Center Competition
Registration deadline: January 16, 2015
Kruger National Park is the largest game reserve in South Africa and is one of the largest national parks in the world. Architecture stu-



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dents and graduates from 2012 or later, from around the world, are eligible to participate in an ideas competition to design a visitor center and educational space on the grounds of the park. Proposals can be submitted individually or by a team (maximum of four members). The winners will be selected by a jury that includes Nathalie de Vries, Federico Soriano, and others. For more information, visit arquideas.net.

2015 Coverings Installation & Design (CID) Awards
Submission deadline: January 20, 2015
Coverings, the largest and most important ceramic tile and natural stone trade fair and expo in the United States, is on the hunt for submissions. Available to architects, designers, builders, contractors, distributors, retailers, and installers, the CID Awards celebrate creativity and technical prowess in the use of tile and stone in residential, commercial, international, and sustainable projects. For more information, visit coverings.com/CID.

2015 AIA COTE Top Ten / Top Ten + Awards
Submission deadline: January 26, 2015
The AIA COTE Top Ten / Top Ten + Awards program recognizes built projects that establish a standard of overall design excellence—creatively integrating sustainable design strategies and demonstrating their benefits while educating and inspiring people in the profession and the public. The awarded projects will receive significant recognition, including acknowledgement in AIA publications, electronic media, and at the 2015 AIA National Convention and Design Exposition in Atlanta. For more information, visit aiatopten.org.

Museum of Science Fiction: International Concept Art
Registration deadline: January 31, 2015
A concept-art competition for the Museum of Science Fiction's 2015 Preview Museum to be located in the Washington, D.C., area, this competition is open to all. It is an opportunity for science fiction artists to share their talent in seven categories: The Creators; Other Worlds; Vehicles; Time Travels; Aliens, Creatures, and Altered Life; Computers and Robots; and Technology. For more information, visit museumofsciencefiction.org

E-mail information two months in advance to recordevents@mcgraw-hill.com. For more listings, visit architecturalrecord.com/news/events.

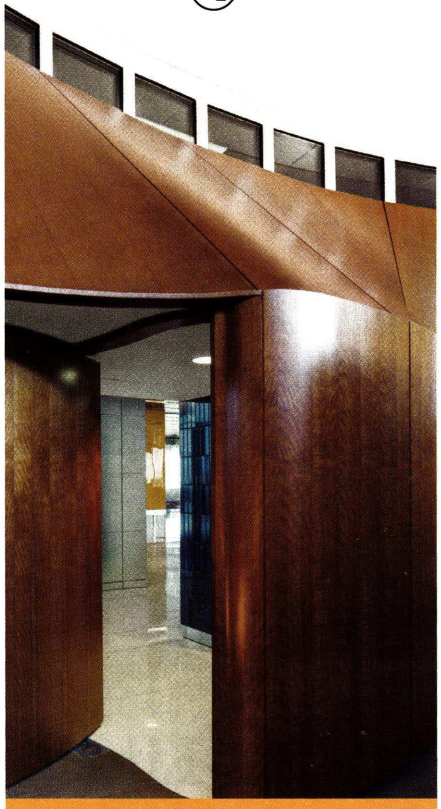
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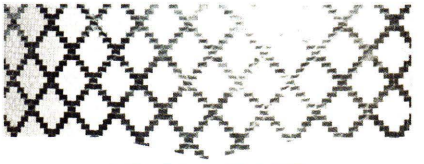
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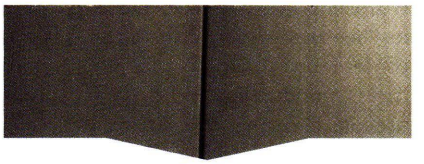
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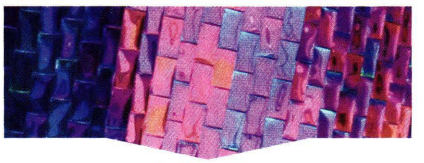
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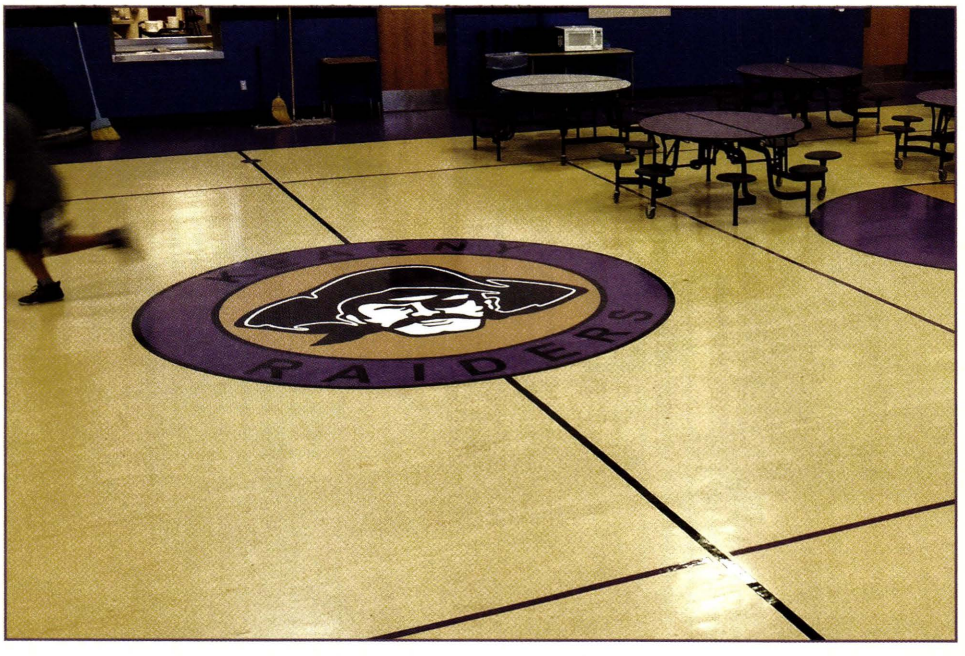
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snapshot

PROJECT D'LEEDON SINGAPORE
LOCATION SINGAPORE
DESIGNER ZAHA HADID ARCHITECTS



THE TOWERS that comprise Zaha Hadid's latest project may look precarious, but they are certainly not faulty: "They change shape and geometry as you move up," explains project director Michele Pasca di Magliano. "That is one of the things Zaha was particularly keen on." Located in Singapore's District 10, the complex, called d'Leedon, consists of seven high-rises and a dozen separate villas. With two major subway tunnels and the main waterline from Malaysia to Singapore criss-crossing the site's underbelly, the structures necessitated careful placement and tight footprints. Surprisingly, the dizzying forms, created in part by variations in balconies and the narrow bases, were not the architects' primary focus. "We designed the void more than the building itself," says di Magliano. The reinforced-concrete towers feature a petal-shaped floor plate achieved through vertical cuts that maximize views for the 1,715 residential units and generate 340 unique apartment schemes. Keys are just now being handed out to the residents, who paid between $1 million and $6 million for a spot in the ultra-luxe complex. Says di Magliano: "We're just waiting for it to come to life."

—Anna Fixsen

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